GREEN SPRING: AN ANASAZI AND SOUTHERN PAIUTE ENCAMPMENT IN THE ST. GEORGE BASIN OF UTAH

Deborah A. Westfall, William E. Davis, Eric Blinman

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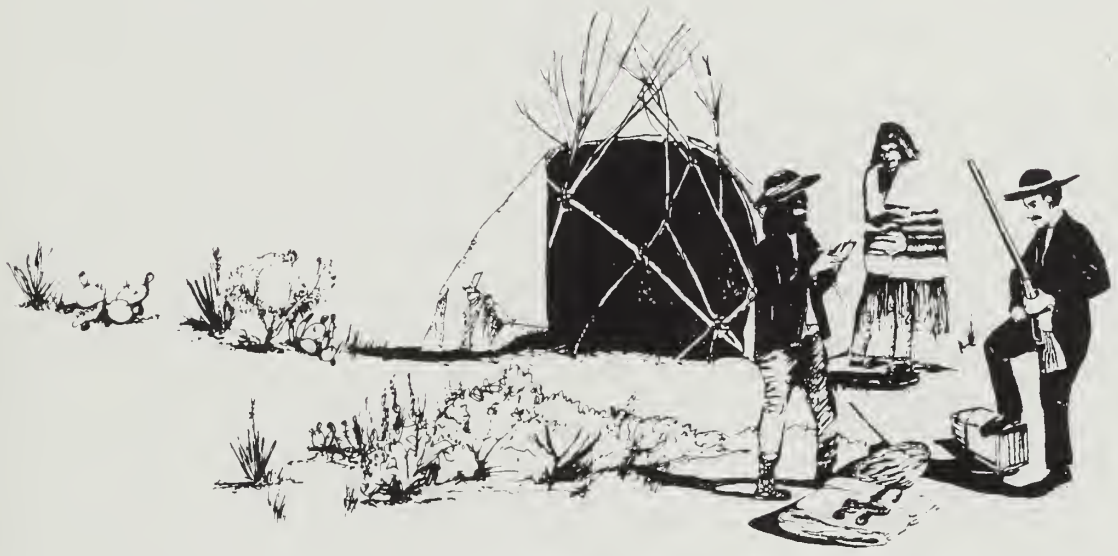
GREEN SPRING: AN ANASAZI AND SOUTHERN PAIUTE ENCAMPMENT IN THE ST. GEORGE BASIN OF UTAH

The Washington City-Green Spring Archaeological Project



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Abajo Archaeology
Bluff, Utah

Cultural Resource Series
No. 21

Utah State Office
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Salt Lake City, Utah

1987

The Washington City-Green Springs archaeological project was undertaken to mitigate potential adverse impacts to cultural resources that would result from a planned recreational project. BLM personnel were instrumental in the project's direction from inception to this point of final reporting. This report demonstrates the successful reconciliation of the goals of modern cultural heritage. It also marks an important step forward in the history of archaeological research in Utah.

Early in its printing history, the Utah BLM Cultural Resource Series stressed the publication of regional summaries as a frame of reference for regional planning and as a basis for developing regional research designs. These were followed by the publication of area-specific excavation reports which filled substantial gaps in the cultural resource data bases of poorly-known culture areas, most notably southwestern Utah. Researchers are now faced with the next step in the process of scientific inquiry: the development of testable hypotheses to explain the range of variations observed in the archaeological record.

This volume represents a successful attempt to reconcile the existing cultural resource data base with current anthropological research concerns that stress a problem-oriented approach to interpreting human behavior from material culture remains in the context of the natural and cultural environment. Using data gathered by past research the authors develop testable hypotheses to explain variation in the material culture assemblages from the Green Spring rockshelters. Using a combination of archaeological, environmental, and ethnographic data to test these hypotheses, the authors propose a model of human behavior to account for the observed variation in the archaeological record at the Green Spring encampment. This study marks an important step in understanding human use of the St. George Basin, and has implications for understanding the social and economic ramifications of a mobile versus a sedentary way of life in a complex geographical area.

With the publication of this report, the Utah Bureau of Land Managment fulfills its obligation to disseminate significant new information to the scientific community and the public at large, and assures its commitment to encouraging the scientific study of Utah's cultural resources.

Richard E. Fike, Series Editor

ABSTRACT

Abajo Archaeology conducted archaeological excavations at a series of six small rockshelters and seven outdoor hearth features located near Green Spring, west of Washington City, Utah. The purpose of the investigations was to mitigate adverse effects to the sites that would be engendered by a proposed R & PP plan to develop the Green Spring area. Of the seven sites, all were completely investigated except two which were sealed by massive collapsed slabs.

The archaeological sites revealed a series of residential camps, specialized resource procurement and processing camps, and transitory camps, occupied by Virgin Anasazi groups during the Pueblo I and Pueblo II periods, and by Southern Paiute groups during the pre-contact and post-contact era.

The analyses of data were oriented toward answering several inter-related problem domains concerning environment and subsistence, technology, exchange, and logistical organization. The results indicate that site use varied through time and is thought to reflect different subsistence emphases as well as the effects of environmental and cultural change. Indications are that the Pueblo I Virgin Anasazi used the Green Spring area as a seasonal residential base, situated so as to exploit a wide-ranging resource catchment area. Material culture items indicate possible seasonal movement to, and exchange with, groups in the Mt. Trumbull/Muddy River area. The succeeding Pueblo II period is marked by a shift in emphasis to specialized resource procurement and processing by small task groups who may have transported resources back to an agricultural settlement located elsewhere. Material culture items indicate a possible shift in group mobility and exchange from the south-southwest to the east-northeast during the Pueblo II period of population expansion.

The available data indicate that the rockshelters were not re-occupied again until around A.D. 1800 by Southern Paiute groups, who utilized the Green Spring area as a seasonal residential base. The post-contact era is represented by a series of ephemeral outdoor hearth features which indicate only highly transitory camping; these are thought to reflect the usurpation of Southern Paiute resource areas by Anglo-American settlers during the colonization of the St. George Basin in the late historic period.

ACKNOWLEDGEMENTS

The successful completion of the archaeological investigations at the Washington City-Green Spring project area was made possible through the interest and cooperation of several individuals. Mr. Gardiner Dalley, BLM Cedar City District Archaeologist, deserves special praise for recognizing the significant research potential of the sites and for coordinating the research efforts with federal, city, and tribal requirements. Mr. Dalley, Mr. Douglas McFadden of the BLM Kanab Resource Area, and Ms. Jennifer Jack of the Arizona Strip BLM visited the project and provided helpful information concerning Virgin Anasazi and Southern Paiute archaeology in the St. George Basin. Ms. Jack also contributed photographs of the rockshelters for use in this publication.

Mr. Robert Slack, Mayor of Washington City, and Mr. Jim Reams (then City Manager) are acknowledged for their support of the archaeological project and for the opportunity to contribute substantial new knowledge about the prehistoric and historic occupation of the St. George Basin.

The field crew, consisting of Mr. Christopher M. Coder of Flagstaff, Arizona, Ms. Andrea Tucker of Rico, Colorado, and Messrs. Barry Frank and Terral Benn of Cedar City are thanked for their competent expertise and cheerful good humor in the recovery of data from the archaeological sites.

The analyses of site material culture were greatly facilitated by the generous assistance of several colleagues. Dr. Fred Nelson of Brigham Young University and Mr. Rick Malcomson of the BLM Arizona Strip District provided useful data on obsidian source analyses. Mr. Mark Bond of Albuquerque, Dr. Robert C. Euler of Prescott, Arizona, Dr. Ann Hedlund of Arizona State University, Dr. Ric Thompson of Intersearch, Cedar City, Utah, and Dr. David Wenger (then of the University of Colorado) all contributed their specialized knowledge to the study of Southern Paiute material culture. Their contributions have allowed a more complete picture of Southern Paiute lifeways than otherwise would have been possible.

Three individuals merit special recognition for contributing their artistic and literary talents toward this publication. Mr. Joe Pachak is thanked for transforming bits of clay, rocks, and history into a picture worth a thousand words for the cover illustration. Mr. Richard Howe is acknowledged for his patient and thorough editing of the diverse writing styles of the various authors. We thank Ms. Julie Smart for her tireless efforts at the IBM work processor and unflagging good humor throughout the innumerable draft revisions that went into the production of this report.

Lastly, but not least, we thank Mr. Rich Fike of the BLM Utah State Office, Salt Lake City, and Mr. Gardiner Dalley for encouraging the publication of this report.

FRONTISPIECE: Southern Paiutes and Anglo-Americans at St. George, Utah, in the late 1880s. (Photograph courtesy of Lynne Clarke Photography, St. George, Utah.)

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CHAPTER I

INTRODUCTION

This report presents the results of archaeological investigations at seven sites located at Green Spring, west of Washington City, Utah. The project area is located in the NE 1/4 of Section 15, Township 42 South, Range 15 West, Washington County, on public land administered by the Utah Bureau of Land Management, Cedar City District (Figure 1.1). The project area is under consideration for development in accord with the Green Springs R & PP Project, jointly administered by the Utah Bureau of Land Management and the City of Washington.

The objective of the archaeological investigations was to mitigate potential adverse effects to the sites that would result from proposed recreational development activities. The accomplishment of this objective was intended to fulfill requirements for compliance with federal mandates governing the recovery of data from significant cultural resources: the National Historic Preservation Act of 1966, the National Environmental and Historic Preservation Act of 1969, and the Archaeological Resources Protection Act of 1979.

The Washington City-Green Spring R & PP project area is situated at an average elevation of 2966 feet, directly west of Green Spring, a permanent spring in the low desert of the St. George Basin of southwest Utah. The sites consist of a series of shallow, south-facing alcoves formed by erosional pockets along an exposed outcrop of the Kayenta Formation and a series of seven outdoor hearths on the ridge slope below the rockshelters (Figure 1.2).

An archaeological survey of the project area was conducted in 1982 by BLM Archaeologists Gardiner Dalley and Douglas McFadden, Utah BLM Cedar City District. Six rockshelter sites (42Ws1629, 1630, 1631, 1632, 1633, and 1634), three outdoor hearths, and one open site (42Ws1635) were recorded. Diagnostic artifacts included prehistoric Virgin Anasazi ceramics and protohistoric Southern Paiute ceramics (data on file at the Utah BLM Cedar City District Office, Cedar City). In October 1984, Dalley and McFadden conducted test excavations at three of the six rockshelters: 42Ws1629, 42Ws1632, and 42Ws1633. The results indicated that cultural depth was present at several rockshelters, and several outdoor hearths were also identified. Virgin Anasazi and Southern Paiute material culture items were recovered, as were faunal bone elements and historic debris. These investigations confirmed the significant research potential of the six rockshelter sites, and recommendations were made to mitigate adverse effects to the rockshelter sites through a program of archaeological data recovery. The seventh site (42Ws1635), a surface lithic scatter, was determined to be non-significant and no further work was recommended.

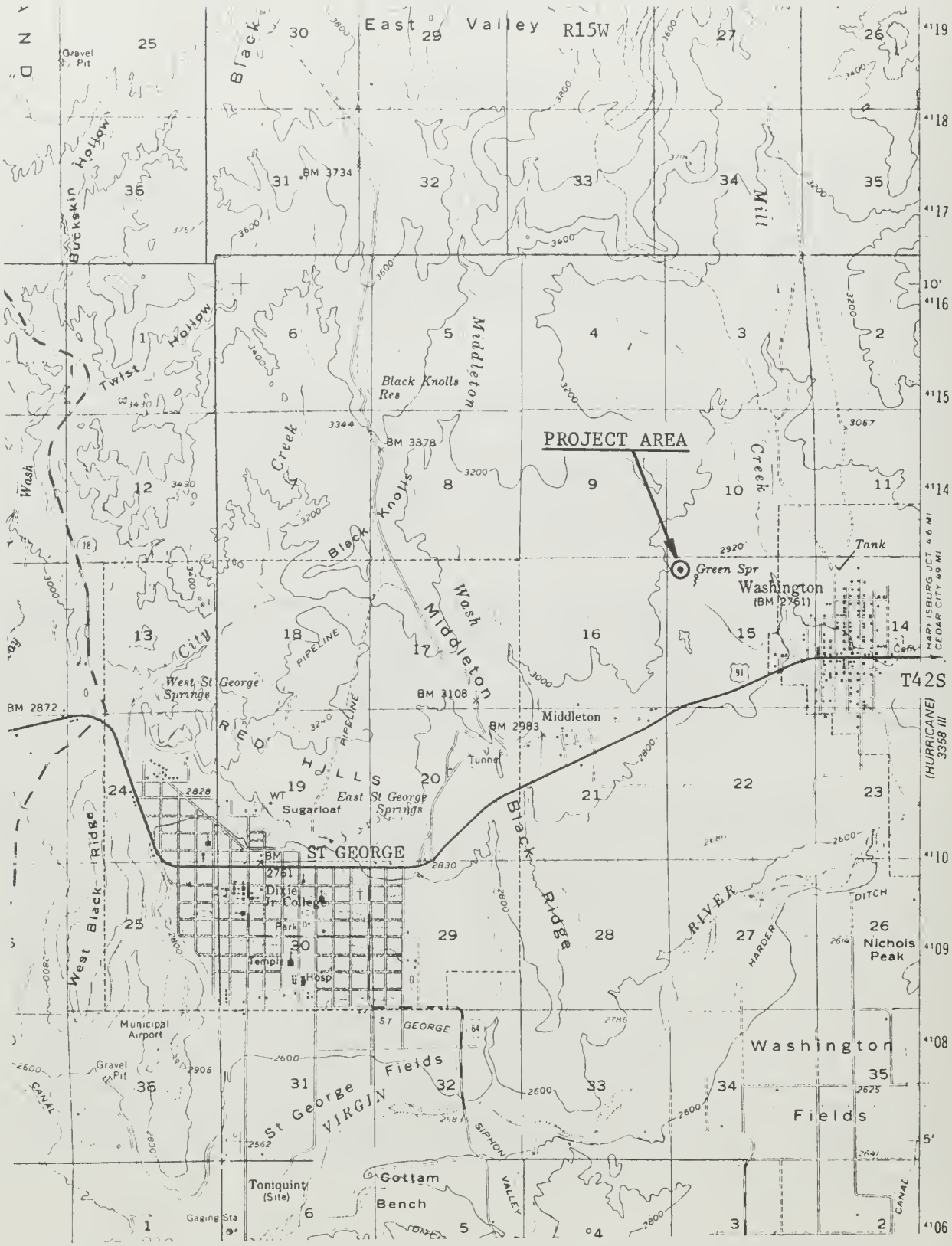


FIGURE 1.1. Project Area Map: Washington City-Green Spring Archaeological Project, Washington County, Utah. USGS St. George, UT, 15', 1954.

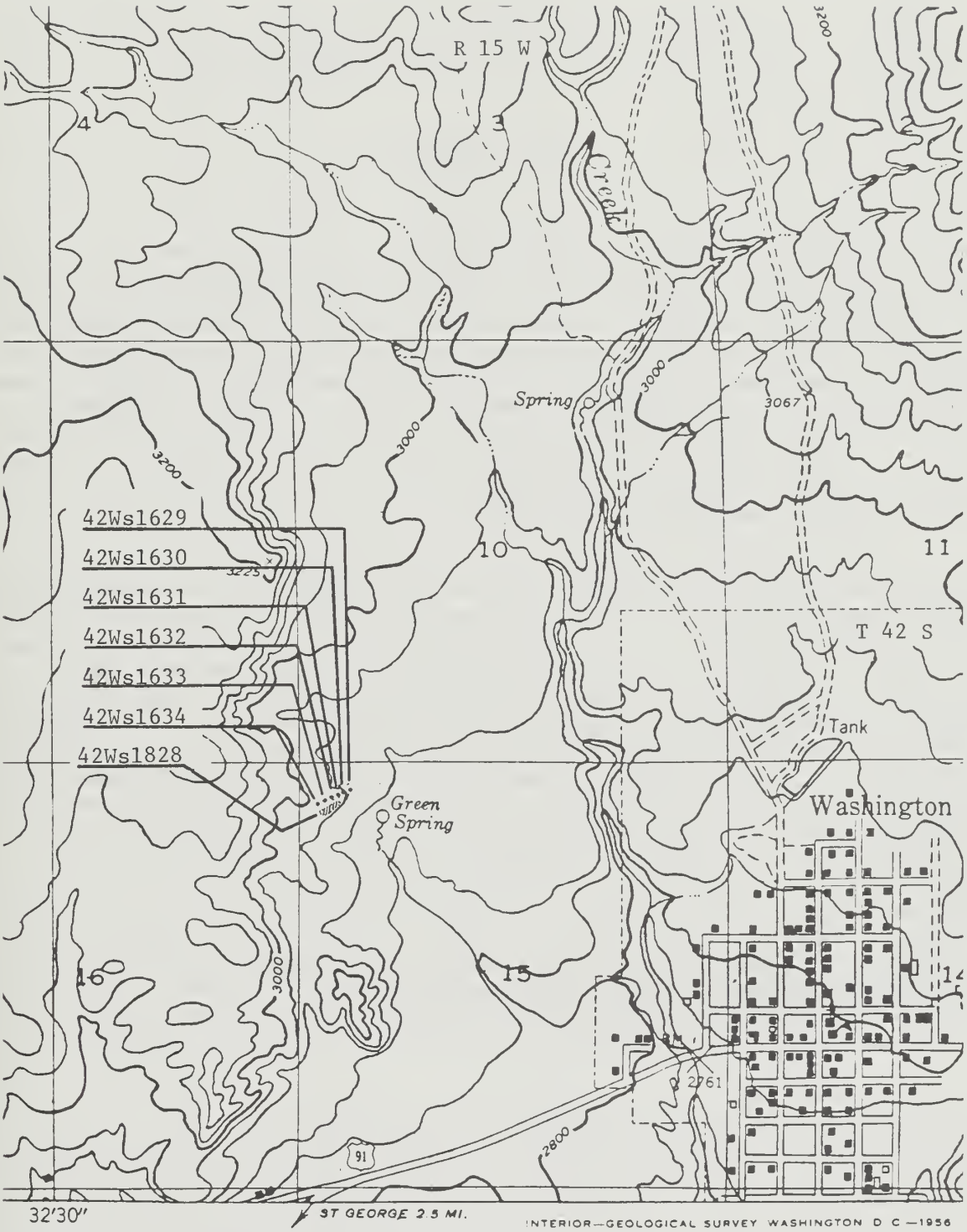


FIGURE 1.2. Site Location Map: Washington City-Green Spring Archaeological Project, Washington County, Utah.
USGS St. George, UT, NE, 7.5' (Preliminary Edition).

Abajo Archaeology conducted mitigative data recovery excavations during September and October 1985. The principal investigator was William E. Davis, Director of Abajo Archaeology, Bluff, Utah. The fieldwork was directed by Deborah A. Westfall, and the field crew included Mr. Christopher Coder, Ms. Andrea Tucker, Mr. Barry Frank, and Mr. Terral Benn. The fieldwork was performed under authority of U.S.D.I. ARPA Permit No. 85-UT-57629 and Utah State Antiquities Permit No. U-85-08-558b(e), issued to Abajo Archaeology, Bluff, Utah.

Each rockshelter site presented a special set of problems, due to different degrees of past vandalism, rodent disturbance, and rockshelter collapse. The interior cultural deposits were uniformly shallow (less than 40 cm deep), and the majority lacked well-defined soil strata. Only one rockshelter, 42Ws1630, contained an interior roasting pit. Nevertheless, intensive screening of stratigraphically controlled excavation units resulted in the recovery of distinctive material culture remains, which clearly indicated use of the rockshelters by prehistoric Virgin Anasazi and historic Southern Paiute groups. In addition to the rockshelters, seven outdoor hearths on the ridge slope below the rockshelters were investigated. These features are subsumed under a new site designation: 42Ws1828.

The present report constitutes a documentation of the archaeological significance of the Washington City-Green Spring Project archaeological sites. Chapter II describes the environmental and culture-historical background of the project area. Chapter III, the project research design, identifies current research problems relevant to the prehistoric and historic aboriginal occupation of the project area, and outlines a series of research problem domains designed to guide the analyses of the data. The individual sites are described in Chapter IV, which constitutes the data base for the analyses of material culture in Chapters V, VI, and VII. The data are then summarized in Chapter VIII, and the relevant research problem domains are evaluated. From these are derived general inferences about the prehistoric, protohistoric, and historic occupation of the Green Spring area, and its relevance to the larger context of the culture history of the St. George Basin.

All recovered materials, field records, and photographs will be curated at Southern Utah State College, Cedar City, Utah.

CHAPTER II

BACKGROUND OF THE PROJECT AREA

Environmental Setting

The Washington City-Green Spring project area is situated at an average elevation of 2966 ft. in the St. George Basin of extreme southwestern Utah. This area is transitional between the Basin and Range and the Colorado Plateau physiographic provinces. The rugged topography is the result of massive faulting and folding begun in post-Jurassic times, which formed fault block ranges and basins (Fowler 1966:15). The St. George Basin is bounded on the north by the Pine Valley Mountains and on the east by the Hurricane Cliffs. To the south rises the Shivwits Plateau, and the Mohave Desert stretches westward to Nevada. The elevation within the St. George Basin ranges from 2600 ft. to 3200 ft. above mean sea level.

The Washington City-Green Spring rockshelters are a series of shallow alcoves along an east-west exposure of the Jurassic Kayenta Formation (Figure 2.1). The Kayenta Formation and overlying Jurassic Navajo Sandstone form a broad expanse of semi-barren rock extending several miles north to the foothills of the Pine Valley Mountains and east-northeast to the lower benches of the Hurricane Cliffs. The Kayenta Formation is composed chiefly of maroon sandstones and colored, banded siltstones. Irregularly interbedded with these rocks are dense white, gray, and pink limestones in layers a few inches thick (Gregory 1948:233). The high permeability of the Kayenta Formation is demonstrated by the steady erosion and spalling of the softer limestone units, which form small alcoves and crevices. Many of these alcoves were utilized by Virgin Anasazi and Southern Paiute groups elsewhere in the St. George Basin (Greg Woodall, Hurricane, Utah: personal communication).

Despite its arid, low desert setting, the St. George Basin is well supplied with an abundance of perennial streams and springs. The Pine Valley laccolith, 7 miles to the north, functions as an important reservoir for water, which is discharged in numerous springs at the base of the mountain (Cook 1954). Green Spring is situated 200 meters directly east of the rockshelters. The spring outflow channel then runs approximately 1.0 mile (1.6 km) southeast of the Virgin River approximately 2 miles (3.2 km) southeast of Green Spring.

Soils in the Washington City-Green Spring project area are composed primarily of gravelly, residual soils derived from in situ weathering of the Kayenta Formation bedrock, and silty sand of eolian origin. The ridge slope between the Kayenta Formation outcrop face and the Mill Creek floodplain below at present is dissected by numerous shallow runnels that have cut down to the underlying bedrock.

FIGURE 2.1. General overview of the project area to the north. The Kayenta Formation outcrop is in the middle ground, and the Pine Valley Mountains in the rear.

The climate of the St. George Basin is typical of low desert settings, marked by extreme temperature gradients and low precipitation. The mean average annual temperature ranges from 39°F to 83°F; the extreme minimum annual temperature ranges from -11°F to 43°F, and the extreme maximum annual temperature ranges from 72°F to 116°F (Dalley and McFadden 1985:13, Table 1). The average annual precipitation is less than 10 inches, with the majority falling as rain during the winter. The remainder falls in summer thunderstorms and is often lost in rapid runoff. April, May, and June are the driest months (Dalley and McFadden 1985:12). The average frost-free period is well over 200 days but due to marginal precipitation, agriculture is possible only with irrigation. Ditch irrigation methods were utilized by the historic Southern Paiute and Mormon settlers along the Virgin and Santa Clara Rivers and are presumed to have also been used by the prehistoric Virgin Anasazi (Shutler 1961).

The location of the St. George Basin, between the Basin and Range province to the west and the Colorado Plateau to the east, has resulted in the transmigration of respectively different floral and faunal species along what is known as the Dixie-Corridor Section (Cronquist et al. 1972:106-107). The Washington City-Green Spring project area contains species associated with the Creosote Bush Association (Hot Desert Shrub Community) and the Blackbrush Association (Cold Desert Shrub Community). Plant species on the ridge slope directly below the rockshelters include the following: creosotebush (Larrea divaricata), range ratany (Krameria parviflora), bursage (Franseria dumosa), Mormon tea (Ephedra nevadensis), little rabbitbrush

(Chrysothamnus viscidiflorus), snakeweed (Gutierrezia sarothrae), desert trumpet (Eriogonum inflatum), prickly pear and cholla cacti (Opuntia spp.), and hedgehog cactus (Echinocereus triglochidiatus). Green Spring, at the base of the ridge, supports a small, but dense aquatic community that includes honey mesquite (Prosopis juliflora), screwbean mesquite (Prosopis pubescens), cottonwood (Populus fremontii), bulrushes (Scirpus), sedges (Carex), and tamarisk (Tamarix).

No native mammals other than birds were sighted during the excavation project, due in part to the close proximity of the project area to suburban Washington City. However, the low desert is known to support a variety of mammals, reptiles, and insects. The Virgin River is a major avian migration route and waterfowl are known to be plentiful in the area. Fowler (1966) has compiled an extensive list of plants and animals which were economically important to the historic Southern Paiute of southwestern Utah, to which the reader is referred for specific, detailed information. In brief, the low desert supported numerous rabbits and rodents, which were an important mainstay of the aboriginal Southern Paiute diet. Mule deer and pronghorn antelope also were hunted, but more often were to be found at higher elevations in the pinyon-juniper woodlands and open sagebrush plains along with other large animal species. Snakes, lizards, and certain insects (e.g., grasshoppers) also constituted important components of the aboriginal diet. Lastly, but no less important, arable land for domesticated plant crops was available along the Virgin and Santa Clara Rivers.

In summary, despite extremes in topography and climate, the St. George Basin was home to diverse communities of floral and faunal resources and was blessed with a number of perennial water sources. These resources were exploited over a long period of time by human populations with varying degrees of success. These cultural adaptations to the environmental constraints of the St. George Basin are explored in Chapter III.

Culture-Historical Background

Previous Research in the St. George Basin

The St. George Basin is within the potential geographic range of several aboriginal cultures: the PaleoIndian, Archaic, Virgin and Kayenta Anasazi, and Southern Paiute. Previous archaeological research has documented no evidence of PaleoIndian occupation, and the evidence for Archaic occupation has been limited to a few surface finds of isolated dart points (Thompson and Thompson 1978; Gardiner Dalley, BLM Cedar City District: personal communication). Most research, conditioned largely by available funding from water conservation, recreation, and electric power projects, has focused primarily on Virgin Anasazi archaeology (Aikens 1965; Dalley and McFadden 1985; Hall 1978; Rudy and Stirland 1950; Spencer 1934; Thompson 1978; Thompson and Thompson 1974). Ethnographic and ethnohistoric research has documented the protohistoric and historic occupation of the St. George Basin by the Southern Paiute, who utilized the basin for agriculture and foraging for plant and animal resources (Euler 1966; Fowler and Fowler 1971, 1973, 1983; Heizer 1954; Kelly 1964; Smith 1974; Steward 1938).

The Virgin Anasazi

The Virgin River drainage has traditionally been considered the "heartland" of the Virgin Anasazi cultural tradition. At its maximum extent, the Virgin Anasazi culture area extended north to the Zion Park uplands, east toward the Kaiparowits Plateau in Utah, south to the Colorado River in Arizona, and west-southwest along the Muddy River in Nevada. The St. George Basin, then, is considered within the larger context of the Virgin Anasazi cultural sphere which encompassed a broad range of mountains, plateaus, and basins.

The Virgin Anasazi were initially defined on the basis of diagnostic pottery, which was used to determine the geographical and temporal range of the Virgin Anasazi cultural tradition (Colton 1954; Gladwin and Gladwin 1934; Spencer 1934). Early archaeological investigations at Virgin Anasazi sites include the Lost City area on the Muddy River in Nevada (Shutler 1961), and several sites in southwestern Utah by the University of Utah (Aikens 1965, 1966). These early investigations formed the basic groundwork for the definition of the Virgin Anasazi tradition. On the basis of parallel trends in ceramic design styles, several authors have argued that the Virgin Anasazi were derived from Kayenta Anasazi groups who migrated to the Virgin River area and evolved a separate cultural tradition while maintaining close contacts with their Kayenta neighbors. Virgin Anasazi sites exhibit several salient differences which distinguished them from the Kayenta Anasazi: C-shaped pueblos, a rare incidence of ceremonial kivas, and evidence of ceramic manufacture specialization.

Shutler (1961) developed a basic chronology for the Virgin Anasazi tradition which was founded on analogs with dated Kayenta Anasazi traits: the Moapa Phase (Basketmaker II: 300 B.C-A.D. 500), the Muddy River Phase (Basketmaker III: A.D. 500-700), the Lost City Phase (Pueblo I-II: A.D. 700-1100), and the Mesa House Phase (Pueblo III: A.D. 1100-1150). Through time, Virgin Anasazi settlements along the Virgin and Muddy Rivers evolved from randomly organized pit house villages to increasingly nucleated pueblo towns, generally thought to be dependent on an agricultural subsistence base (Aikens 1965, 1966, Dalley and McFadden 1985; Shutler 1961).

Elsewhere, archaeological investigations at small sites in the hinterlands of southwestern Utah and northwestern Arizona have contributed information about small, special-use sites and hamlets used by the Virgin Anasazi for a variety of mixed subsistence activities (Janetski and Hall 1983; Metcalfe 1981; Moffit et al. 1978; Nickens and Kvamme 1981; Rudy 1954; Westfall 1985a, 1985b). Detailed analyses of botanical and faunal remains, and intensive study of lithic tool and ceramic vessel assemblages have shown that the Virgin Anasazi relied on hunted and gathered resources in these hinterland areas, where only small-scale farming was feasible. Research at small sites such as these has demonstrated that the Virgin Anasazi did not follow a normative evolutionary sequence from small farming hamlets to nucleated agricultural towns; rather, they availed themselves of a variety of different environmental ranges for various subsistence needs throughout the prehistoric period. Hence, a major research issue now facing archaeologists is understanding how these different subsistence pursuits were

integrated into the cultural system manifested by the wide variety of different site types found in the Virgin Anasazi cultural area.

By A.D. 1150/1200, the Virgin Anasazi had ceased to exist as a recognizable cultural entity. Gunnerson (1962) has suggested that deteriorating agricultural conditions forced the Virgin Anasazi to return southeast to the Kayenta homeland. Others have suggested that Southern Paiute bands, better equipped to survive conditions of environmental stress, may have successfully competed for scarce resources, ultimately hastening the demise of the Virgin Anasazi cultural tradition (Aikens 1970; Euler 1964; Madsen 1975; Thompson and Thompson 1982).

The Southern Paiute

The Southern Paiute are members of a southern Numic population (Uto-Aztecan speakers) who occupied the southern Great Basin and adjacent Colorado Plateau along a broad band paralleling the north-northwest bank of the Colorado River in Utah, Arizona, Nevada, and California. The Southern Paiute are believed to have entered southwestern Utah sometime during the period A.D. 1050-1150, based on the co-occurrence of Virgin Anasazi and Southern Paiute ceramics in several stratigraphic contexts (Euler 1964; Fowler and Fowler 1981; Shutler 1961; Shutler et al. 1960; Rudy 1954).

The Southern Paiute were essentially semi-nomadic hunter-gatherers, adapted to a lifeway of seasonal transhumance across a broad elevational range that encompassed basin and range, high plateaus, and canyonlands (Euler 1966; Kelly 1964; Sweeney 1966). The Southern Paiute were organized into independent family bands who followed an annual subsistence round. In the autumn, groups moved up onto the plateaus to collect pinyon nuts and yucca fruit, and to hunt deer. Stores were cached for the winter, but ordinarily winter and early spring could be times of near-famine unless trips were made to the rim of the Colorado River to gather cacti, mescal, and juniper berries. In summer, groups returned to springs and other perennial water sources at the foot of the plateaus and there gathered seeds, berries, greens, and roots. Small game constituted the principal source of meat throughout the year; specialized hunting groups would range out for larger game such as mule deer, bighorn sheep, and antelope (Kelly 1964).

Several scholars have suggested that the Southern Paiute may have learned horticultural methods from the Virgin Anasazi (Euler 1964; Fowler and Fowler 1981; Fowler, Madsen and Hattori 1973; Steward 1938). The subject has been debated for several years, but to no conclusion. At any rate, the practice of horticulture distinguishes the Southern Paiute from the other more northerly Ute bands of the Great Basin. Ditch irrigation was utilized by the more westerly bands along the Virgin, Santa Clara, and Muddy Rivers, while the easterly bands (e.g., Kaibab Paiute) situated small farm plots near seeps and springs (Euler 1966; Kelly 1964). Ethnohistoric sources cite several instances where the Spanish explorers of the period A.D. 1776-1777 described the cultivation of corn and squash by Southern Paiute, and also mentioned trade (Euler 1966:111-113). Trade would have been a necessary component of a transhumant lifeway in order to ensure adequate provender for groups lacking direct access to desirable resources (e.g., exchange of domesticated foodstuffs for gathered wild food items).

As befitting a semi-nomadic lifeway, Southern Paiute material culture was relatively basic, conservative, and portable. Euler (1966:114) has commented that the chronological sequence from 1776 to the late 1870s reveals that Southern Paiute material culture items remained fairly stable. These included conical-bottomed plain brownware pottery vessels sometimes decorated with fingernail incisions, basketry for hats and containers, rabbit fur robes, rabbit nets, bows and arrows, woven mats and bags, animal hide clothing, digging sticks, milling stones, and various expedient stone tools. Through trade, the Southern Paiute obtained turquoise from the Hopi, buffalo robes from the northern Utes, and cloth and tools from the Anglo-Americans. Very little data are available on Southern Paiute burial customs. The available information indicates that the corpse was generally wrapped in a blanket and interred in the ground (Euler 1966:62), or was placed within a rock crevice or cave (Smith 1974:150). Nickens (1984) has compiled data that indicate crevice burials were fairly common among the Utes in the 19th century, but there is little information about Southern Paiute crevice burials.

The Southern Paiute utilized a variety of settings and resources for their settlements and camps. Dwellings usually consisted of wickiups constructed of bent willow and cottonwood branches, overlain with brush or juniper branches (depending on the locality). Several authors have documented Southern Paiute occupation of rockshelters (Euler 1966; Fowler, Madsen and Hattori 1973; Shutler 1961), and open camp sites are ubiquitous, consisting chiefly of hearths, roasting pits, wickiup depressions, and artifact scatters (Heizer 1954; Moffit et al. 1978; data on file at the BLM Cedar City District Office).

Although these survey data document Southern Paiute occupation of the St. George Basin, few sites have been systematically investigated to ascertain their age and function in the Southern Paiute cultural system. More specific data are available from sites excavated in the Beaver Dam Mountains, approximately 18 miles southwest of Green Spring (Moffit et al. 1978). These sites, for the most part, consisted of several rock-filled roasting pits, hearths, and one site also contained three shallow wickiup depressions. The material culture assemblage at these sites included a variety of cutting, scraping, and pounding tools, as well as numerous projectile points. These, and diagnostic ceramic types indicated occupation by Archaic, Virgin Anasazi, and Southern Paiute, with the most intensive occupation attributed to the Southern Paiute. Radiocarbon dates obtained for the Southern Paiute occupations ranged from A.D. 1420 to A.D. 1755. Pollen and macrofloral evidence, along with substantial hunting tool kits, indicated that these sites were used for procuring and processing agave, yucca, cactus fruit, and also for hunting large game (Moffit et al. 1978:5-48).

Small sites such as these have rarely been reported in the ethnographic literature. They constitute an important, little-known dimension of Southern Paiute lifeways. Their significance lies in the fact that the Southern Paiute were primarily hunter-gatherers maintaining a pattern of seasonal transhumance even after the adoption of horticulture to the subsistence base. This ability to exploit a wide range of different resources was the key to survival in the event of agricultural failure and the loss of agricultural lands to the gradual encroachment of Mormon colonizers in the late 19th century (cf. Powell and Ingalls 1874).

CHAPTER III

RESEARCH DESIGN

Theoretical Orientation

The interpretation of the prehistory of the Southwest has always included an element of cultural ecology. While no one goes so far as to assume environmental determinism, most researchers study archaeology from a perspective in which the interaction between humans and their environment is an essential component of understanding human behavior (Braun and Plog 1982; Plog 1984).

Understanding and explaining prehistoric and historic aboriginal behavior generally requires a basic understanding of human ecology. This was aptly put by Julian Steward (1938:2) who defined human ecology as "the modes of behavior by which human beings adapt themselves to their environment. Any adaptation necessarily involves an interaction of two elements: the natural environment and the particular cultural devices...by which the environment is exploited." The study of human ecology requires consideration of (1) the features of the natural landscape or environment, and identification of resources exploited by aboriginal populations (environment and subsistence), (2) the cultural devices used to exploit necessary resources (technology and the logistical organization of groups for procuring desired resources), (3) the resulting adaptations of human behavior (settlement patterning), and (4) chronological order (seasonal scheduling and historic processes). From these synchronic analyses of material culture patterns are derived diachronic interpretations of cultural processes that conditioned the evolution of cultural systems in the prehistory of the region. The St. George Basin, with its well-documented high agricultural potential, accessibility to a wide variety of natural resource areas, and density of archaeological sites, is an ideal setting for developing and testing models of human adaptation to arid environmental conditions.

Culture Ecology in the St. George Basin

The culture-historical overview summarized in Chapter II has shown that the St. George Basin was an important resource area for Virgin Anasazi and Southern Paiute groups. Archaeological and ethnohistoric data indicate that aboriginal horticultural settlements were situated along the Virgin and Santa Clara Rivers and their major tributaries. Seasonal base camps and special-activity sites are generally found in a transitional foothills zone between the lower basin floodplain and the surrounding plateau and mountain ranges.

Traditional models that attempt to explain this kind of settlement patterning generally portray the Virgin Anasazi as agriculturalists who established permanent villages along major streams (Shutler 1961; Aikens 1966; Dalley and McFadden 1985). Thompson and Thompson (1982) also propose a predominantly agricultural adaptation, and follow Berry (1974) in suggesting

that the Virgin Anasazi may have been forced into a predominantly foraging subsistence strategy as a result of deteriorating agricultural conditions in the terminal years of their occupation of southwest Utah. Others have argued for a strategy incorporating a subsistence mix, which accommodated horticulture, hunting, and gathering (Janetski and Hall 1983; Moffit et al. 1978; Nickens and Kvamme 1981; Westfall 1985). In all likelihood both strategies were possible with different emphases on horticulture conditioned by the availability of adequate water sources and access to agricultural lands.

One significant attribute that distinguishes the Southern Paiute is the inclusion of horticulture in a predominantly hunting and gathering economy. The degree of Southern Paiute reliance on horticulture is debated among scholars (Manners 1959; Stoffle and Dobyns 1983), and is relevant to archaeological studies insofar as ethnographic models are used to test assumptions about prehistoric subsistence and settlement patterns (cf. Janetski and Hall 1983; Powell 1983). It is beyond the scope of the present study to resolve the issue of different degrees of reliance on horticulture for both the Virgin Anasazi and Southern Paiute; however, analyses of the Washington City-Green Spring Project sites can provide substantial information about the role of small, special-use sites in the larger context of aboriginal subsistence and settlement in the St. George Basin in particular, and Virgin Anasazi-Southern Paiute cultural ecology in general.

Current theoretical literature concerned with defining pre-contact aboriginal subsistence and settlement strategies has developed general models and archaeological expectations for different subsistence-related activities. Particular subsistence activities condition the structure and function of task groups, leading to different degrees of logistical organization and group mobility (Binford 1980, 1982; Powell 1983). Populations engaged in intensive agriculture would be expected to generate substantial domestic and storage facilities, a number of special-use features for processing agricultural products, and substantial trash midden debris. The Red Cliffs Site, located approximately 10 miles northwest of Green Spring along Quail Creek, represents one such type of agricultural settlement (Dalley and McFadden 1985).

It must be stressed that intensive agriculture in arid lands is a very specialized, labor-intensive strategy requiring the support and deployment of relatively large groups of families. With the majority of a population tending to agricultural pursuits, relatively small task groups would have been deployed to collect specific necessary wild resources. Agricultural groups would have exploited a narrower range of wild resources than eclectic hunting-gathering-horticultural populations since agricultural surplus could be stored for future needs at residential settlements. Hence, in order to obtain wild resources special task groups may leave a residential settlement and establish a temporary field camp from which collecting operations could be planned and executed. Food or other supplies brought to these field camps would then be processed to facilitate transport back to the residential settlement (Binford 1980:10).

On the other hand, populations engaged in a mixed subsistence strategy would be expected to generate a series of seasonal, residential base camps in different resource areas and ancillary, special-activity sites peripheral to the residential base. Residential base camps are defined as "the hub of subsistence activities, the locus out of which foraging parties originate and where most processing, manufacturing, and maintenance activities take place" (Binford 1980:9). Special-activity sites used by foraging parties are locations where resources were procured on a daily "encounter" basis. Such resources would have been minimally processed to a low-bulk size to facilitate transport back to the residential base.

The preliminary data indicated that the Washington City-Green Spring rockshelters could have functioned as (1) residential base camps, or (2) specialized resource procurement-processing locations associated with a generalized foraging strategy similar to that documented for the pre-contact Southern Paiute, or (3) a series of specialized field camps utilized by agricultural groups engaged in collecting wild resources which were then transported back to agricultural settlements.

The evaluation of these alternative models of site function will utilize data subsumed under the following general problem domains: (1) the chronological and cultural affiliation of the sites, (2) the environment and subsistence base, (3) the technology used to procure and process resources, (4) systems of exchange, and (5) the logistical organization of site activities. These are explicated below.

Research Problem Domains

Chronology and Cultural Affiliation

The preliminary evidence indicated that the Washington City-Green Spring rockshelters were occupied during the Pueblo I-II period of the known Virgin Anasazi sequence, and at some time during the history of Southern Paiute and Anglo-American occupation extending to the present time. The presence of charred organic remains in some of the rockshelters and hearths indicated a good potential for dating, and diagnostic artifacts occurred in sufficient quantity to permit a general chronological reconstruction.

Environment and Subsistence

Because of the environmental features described in Chapter II, agriculture is possible only by some means of water control, such as ditch irrigation in the Virgin River floodplain or along one of the river's perennial tributaries. Similar arid conditions also prevailed in the prehistoric and protohistoric past, as indicated by Virgin Anasazi and Southern Paiute irrigation systems along the Virgin River drainage. On the other hand, the natural landscape of the St. George Basin is host to a variety of wild plant and animal species and a number of perennial springs, such as Green Spring. Gardiner Dalley eloquently characterized the St. George Basin thus:

> Viewed on a full summer midday with the temperature at 110°F, the sky cloudless and brassy, the soil hot and powder dry, the spring grasses and forbs reduced to chaff, the shrubs brittle and apparently lifeless, and not a creature in sight, it is difficult not to consider the site area and environs harsh and difficult--if not totally inhospitable and uninhabitable. On the other hand, given a day in late March...the 70°F temperature, warm damp sand, magnificent vistas, blooming trees and shrubs, and a carpet of spring greenery do not look all that bad--perhaps something on the order of the Garden of Eden, West.
>
> ...One resource that must have been very attractive, both in the immediate site area, as well as in the St. George Basin in general, is relatively abundant live water (Dalley and McFadden 1985:11,15).

Green Spring, aptly named, is a small riparian oasis situated in the rocky lower foothills bordering the Pine Valley laccolith northwest of Washington City. The Virgin River is approximately 2.5 miles distant, to the southeast. The native aquatic vegetation currently surrounding the immediate vicinity of the spring includes mesquite trees (Prosopis), bulrushes (Scirpus), reeds (Phragmites), cattails (Typha), and sedges (Carex). These plants were economically valuable to the Southern Paiute (Euler 1966; Jones 1948; Heizer 1954). Directly west of Green Spring rises the low Kayenta Sandstone outcrop with its six small rockshelters. The low slopes of the ridge support a mixed plant community, incorporating species indigenous to the Hot Desert and Cold Desert shrub communities (see Chapter II). Known economic species on the ridge slope are much more limited, and include Mormon tea (Ephedra), rabbitbrush (Chrysothamnus), and prickly pear and cholla cacti (Opuntia). Small mammals such as rodents and lizards inhabit small crevices in the inner recesses of the rockshelters.

Existing archaeological subsistence data (Nickens and Kvamme 1981; Moffit et al. 1978; Tucker 1983; Westfall 1985) show that the Virgin Anasazi availed themselves of a variety of wild plant and animal resources in addition to domesticated plants such as corn and squash. Euler (1966) has compiled a list of plant and animal resources utilized by the Southern Paiute, and more detailed information about Southern Paiute ethnobotany has been compiled by Bye (1972), who utilized documentary records and specimen collections made by John W. Powell and Edward Palmer in the 1870s. These data will provide the basis for identifying economically significant environmental resources in the Washington City-Green Spring project paleobiological record.

Assuming that the prehistoric inhabitants were agriculturalists, Green Spring may have been a favored location for special activity groups to acquire a limited range of wild resources, primarily during the spring and summer months, for transport to a permanent village located elsewhere. Since stored agricultural surplus at the permanent village would have provided winter sustenance, use of Green Spring would probably have been limited to the spring-summer months. These task groups would have exploited a limited range of resources, since agricultural produce would have satisfied a large percentage of nutritional and other economic requirements.

On the other hand, foragers engaged in a more eclectic hunting-gathering-horticulture strategy more likely would have exploited a wider range of wild resources. If such groups followed a pattern of seasonal transhumance, such as that documented for the Southern Paiute, the use of Green Springs may have occurred during a more extended spring-to-early fall season. The Green Spring rockshelters could have been used either as residential base camps, resource gathering and processing loci, or as both.

Technology (Material Culture)

Technology is the means by which prehistoric groups procured and processed resources in the course of daily activities oriented toward basic subsistence needs and other components of a cultural system. These include the manufacture and use of containers (e.g., ceramic vessels, baskets, and hide sacks); the production, use, and maintenance of stone, bone, antler, and wood tools; and the construction of shelter, storage, and processing facilities. The association of tool kits with facilities (features) should provide information about the logistical organization of different types of subsistence-related tasks having functional, cultural, and temporal significance.

Given the model of occupation by specialized collectors from agricultural villages, a restricted range of specialized tool types and tool kits should be present, as well as short-term shelter and storage facilities. No doubt the rockshelters provided shelter; however, it is probable that lightweight containers such as baskets would have been used for temporary storage, and are not present in the material culture assemblage. However, low variation in tool kits should correlate with low variability in the botanical and faunal record to indicate resource specialization.

Alternatively, a more eclectic foraging strategy would be indicated by greater variability in tools and tool kits, and greater variation in rockshelter use (e.g., as residential base camps and/or as stations for processing a variety of different resources). It is expected that variability in tool kits will be correlated with a broad spectrum of pollen, macrobotanical, and faunal remains, implying a more generalized subsistence base.

Containers

Portable containers were among the most basic pieces of equipment used by aboriginal groups for whom hunted and gathered resources constituted an important component of the subsistence base. These containers were used for storage, transport, and for preparing foods (e.g., boiling and serving). Container attributes such as shape and volume can be used to infer intended function. Variability in function can be used to evaluate change in technology and the implications for economic and social organization (Blinman 1985). Due to different degrees of preservation and conservation, containers in the archaeological assemblage from the rockshelters are practically limited to ceramic vessels. Hide and basketry containers are known to have been used by Virgin Anasazi and Southern Paiute groups; in the absence of actual specimens, tools such as stone drills and bone awls are generally used to infer hide and basketry container manufacturing.

Ceramic vessels play diverse functional roles in a subsistence system, including cooking and serving foods, dry storage, and liquid storage. Different proportions of vessel forms are used to infer different emphases on specific subsistence tasks. From these are derived inferences about site function. For example, in a recent study which compared ceramic assemblages from a habitation site and a short-term camp, Blinman (1986) found a lower ratio of bowls to jars in the former, and a higher ratio of bowls to jars in the latter. It was concluded that these different bowl-to-jar ratios were the result of different subsistence emphases at the two types of sites. Cultigens at the habitation site were subjected to extended boiling, resulting in a higher frequency of jar use and breakage. On the other hand, the higher ratio of bowls to jars at the short-term camp indicated less use of jars for extended boiling. Also, the higher ratio of bowls to jars could be a result of using bowls for temporary storage of gathered foodstuffs prior to long-term storage in jars. Hence, different relative frequencies among different vessel forms can potentially inform on site function.

Flaked Stone Tools

It is expected that the quantity and diversity of artifact types will be related to site function. Residential sites are locations of tool manufacture, resource accumulation, resource processing, temporary storage, redistribution, and consumption. Residential sites should have not only more lithic artifacts, but also a wider range of tool types than short-term special-activity sites. Short-term seasonally-occupied sites should produce a more restricted range of tool types, indicating functional and/or seasonal specialization.

The characterization of lithic manufacturing tool kits and resource procurement/processing tool kits should aid in determining relative emphases on the specific resources obtained by the inhabitants of the Green Spring rockshelters. If small mammals (e.g., rabbits and rodents) were the primary prehistoric game resource in the St. George Basin, and small mammal hunting and butchering occurred in the vicinity of Green Spring, it is unlikely that the lithic tool kit associated with this activity would be highly specialized. Southern Paiute groups more commonly used nets to entrap rabbits; hence, it is expected that weaponry (e.g., arrow points) will be minimally represented in the assemblage. Butchering tools are likely to consist of small, casually flaked, expedient tools, since small mammals (and reptiles) required only minimal preparation for consumption. In contrast, large game hunting and butchering required a formal tool kit that included flaked projectile points, cutting tools, scrapers, and choppers.

The accessibility and availability of lithic raw material will be explored by analyzing site assemblage composition and by evaluating site location as it relates to lithic raw material sources in the vicinity of Green Spring, as well as long-distance sources.

Definition of assemblage composition and delineation of lithic reduction and tool use areas will provide information on inter-site patterning of resource processing activities. If lithic technology reflects change through

time in response to the needs generated by different subsistence strategies, then that change should be reflected in tool forms and in the by-products (debitage) of that technology.

Grinding Implements

Grinding implements, such as handstones, manos, grinding slabs, and metates were used for a variety of tasks: corn grinding, seed grinding, pulverizing plant and animal parts, crushing tempering materials for pottery, and the like. Raw materials are available in the immediate vicinity of Green Spring: cobbles in the Quaternary gravel alluvium, slabs from the Kayenta Formation Sandstone, and basalt rocks occur in scattered locales.

Most researchers generally acknowledge two basic food grinding kits: the rectangular two-hand mano with the troughed metate for corn grinding, and the oval-to-subrectangular handstone (or one-hand mano) which was used to crack and grind nuts and seeds on flat or basin grinding slabs. Variation in the raw material composition of grinding implements, ranging from relatively soft fine-grained sandstones to very hard porous vesicular basalt, may further indicate selective usage of specific tool kits to process specific resources. Less well represented are mortars and pestles, used for reducing mesquite pods. More often than not, mortars were made of wood and are not well represented in the archaeological record due to their perishable composition and portability.

Although ethnohistoric accounts provide little detailed information about the form and function of Southern Paiute milling stones, visual examples can be seen in the well-known Hillers photographs taken in 1872-1873 (Steward 1939; Euler 1966). In these photographs the majority of grinding implements appear to be rectangular slabs with a slight end-to-end ground concavity, and the upper handstones (or manos) are relatively short, thick subrectangular cobbles. These artifact forms are similar to those used by the Pai, a Yuman-speaking group in northwestern Arizona who, prehistorically, were hunter-gatherers and also practiced limited horticulture (Euler and Dobyns 1983). The Pai used three different milling tool kits for different purposes: (1) a mortar and pestle (of stone or wood) to crush mesquite pods, (2) milling slabs and mullers of stone to crush soft foods and to crack grains by pounding (the muller was also used to crush cracked grain by pressure), and (3) oval basined grinding slabs with mullers rubbed in a circular motion to grind small seeds (Euler and Dobyns 1983:260). Euler has noted further that Southern Paiute sites in the Virgin River drainage have milling stones and manos identical to those used by the Pai, and also that these tool kits were in use as late as the 1950s on the Kaibab Paiute Reservation (Euler and Dobyns 1983:264). The Pai ethnoarchaeological study will serve as a useful basis for comparison with the Washington City-Green Spring Project ground stone tool assemblage in order to evaluate Virgin Anasazi and Southern Paiute grinding tasks. Ultimately, comparative artifactual, botanical, and faunal data should provide substantive information on kinds of resources processed with the milling stones at the Washington City-Green Spring rockshelters.

Shelter, Storage, and Processing Facilities

The rockshelters at Green Spring obviously were used for shelter, and perhaps for temporary storage of resources. If one or more of the rockshelters functioned as a residential camp, evidence should exist for extended camping activities. These should be manifested by the presence of hearths, storage facilities, and trash midden deposits. Test excavations at one rockshelter, 42Ws1632 did reveal fairly substantial midden deposits (Dalley 1984); however, the roof of this shelter had collapsed, and the inaccessibility of the material culture deposits precluded a full and complete assessment of the site.

Use of the rockshelters as temporary camps for specialized resource collecting activities would be indicated by an absence of interior architecture, and correspondingly limited material culture assemblage. The presence of exterior hearths on the ridge slope below the rockshelters may be associated with the occupation of the Green Spring area for specialized or transient activities.

Exchange

Exchange (or trade) constitutes an important, but little-studied aspect of aboriginal culture systems in southwestern Utah. Shutler (1961) has discussed trade in turquoise, salt, and shell among the Virgin Anasazi and other puebloan groups of the Southwest. Ethnographic sources occasionally refer to Southern Paiute trade with the Hopi, Mohave, and Euro-Americans. While prehistoric exchange has been acknowledged by archaeologists working in the area, particularly with respect to ceramics, the subject has rarely been examined in detail as it relates to the maintenance of cultural systems along with subsistence, technology, and logistical and social organization.

Non-local items at the Washington City-Green Spring sites include ceramics and lithic raw material types. The variety of ceramics reported in the survey and testing data indicates the presence of Moapa, Shinarump, and Tusayan Gray and White Wares: Virgin Series, associated with the Virgin Anasazi occupation of the rockshelters. Different proportions of these ceramics can potentially inform on rates of exchange among local and non-local populations.

It has generally been thought that the Moapa wares were produced in the Muddy River Valley, Nevada. However, Weide (1978) has shown through petrographic analysis that the olivine temper used in Moapa pottery was apparently derived from the Mt. Trumbull area in Arizona, implying that Moapa ceramic production was centered in this area. Shinarump wares, on the other hand, appear to have originated in the vicinity of Johnson Canyon east of Kanab, as indicated by the presence of iron or manganese in the ceramic paste (Wilson 1985). Virgin Series ceramics appear to have had a relatively widespead distribution, and at present no single major production area has yet been defined.

It is important to note the different proportions of these ceramic wares at archaeological sites since they may be correlated with differences in site function. For example, excavations at substantial habitation sites

have documented relatively high proportions of Virgin Series ceramics (Dalley and McFadden 1985; Nickens and Kvamme 1981; Shutler 1961), while Shinarump wares dominated at small, limited activity sites in the Vermilion Cliffs area east of Kanab, Utah (Wilson 1985). Both Shinarump and Moapa wares were well represented at Virgin Anasazi camps located along the Navajo-McCullough Transmission Line across the Arizona Strip and southwestern Utah (Moffit et al. 1978). Hence, varying relative frequencies of different wares not only might be related to distance from centers of ceramic production, but also can inform on differences in site function. It is expected that transhumant population groups would have been more likely to participate in exchange systems, thereby acquiring more mixed pottery vessel collections, than would sedentary agricultural populations.

Additional support for the hypothesis that transhumant groups are more likely to have acquired products through exchange should be gained from assessing the raw material composition of lithic artifacts. In particular, the presence of obsidian indicates possible acquisition from various sources: Modena, Utah; Milford, Utah; and sources near Mt. Trumbull and the Kaibab Plateau, Arizona (R.D. Malcomson, Arizona Strip BLM and Dr. Fred Nelson, BYU: personal communication). Analysis of obsidian source reduction stages can shed light on the method of procuring this resource.

Southern Paiute exchange during the historic period should be indicated, of course, by the presence of Euro-American manufactured goods such as machine-woven textiles, metal items, and the like.

Logistical Organization

Given the models of differentially structured resource procurement activities proposed for the Virgin Anasazi and Southern Paiute, delineation of the logistical organization of on-site activities will be fundamental to the proposed study. This will be accomplished by correlating the occurrence and distribution of site features with environmental, subsistence, and technological data. Chronological data will be used to organize the different activities in time.

(1) If one or more of the rockshelters functioned as a residential camp in a biseasonal, transhumant pattern such as that documented for the Southern Paiute, it is expected that occupation during the spring-summer-fall would be indicated by high variability in the botanical and faunal record, as well as in the material cultural assemblage.

(2) If the rockshelters were used as locations for short-term foraging by these groups, a more restricted range of wild resources would be represented in the botanical and faunal record, and the material culture assemblage would be characterized by low variability.

(3) If the rockshelters were used as collecting stations by specialized task groups deployed from agricultural settlements, the botanical and faunal records and material culture assemblages are likely to be generally similar to those expected for foraging camps, with the addition of domesticated species. Moreover, a higher frequency of Virgin Series ceramics also should be represented.

To understand the function and role of the Washington City-Green Spring rockshelter sites in the context of aboriginal subsistence and settlement systems, data from contemporaneous sites will be used to compare general inter-site attributes. The theoretical orientation of the present study presupposes the existence of contemporaneous agricultural settlements in the St. George Basin (cf. Dalley and McFadden 1985), and seasonal camps in outlying ecological settings (cf. Moffit et al. 1978; Heid 1982; Westfall 1985a; Wise 1986). The results of this analysis will be used to reconstruct a diachronic model of prehistoric adaptation to the St. George Basin with particular relevance to the Virgin Anasazi and the Southern Paiute.

Synthesis

The results of the synchronic analyses of Virgin Anasazi and Southern Paiute chronology, environment and subsistence, technology, logistical organization, and exchange will be integrated to produce a diachronic analysis of cultural adaptation in the St. George Basin. A comparison of the archaeology of the Washington City-Green Spring project with the results of other published studies in the region should provide significant new information about the role of the St. George Basin in the larger cultural and environmental context of Virgin Anasazi and Southern Paiute prehistory and history.

CHAPTER IV

EXCAVATION METHODOLOGY AND SITE DESCRIPTIONS

Excavation Methodology

The investigation of the Washington City-Green Spring project sites commenced with the establishment of a Cartesian grid system over the entire ridge and lower slope, using a Brunton pocket transit mounted on a tripod (Figure 4.1). Systematic, consistent excavation techniques were implemented at each rockshelter site. A 1-m by 1-m square pit was initially excavated to determine the depth of cultural fill and to identify stratigraphic levels. These initial exploratory pits were subsequently expanded into trenches by excavating contiguous 1-m by 1-m units, until all data necessary for answering relevant research questions were obtained. Generally, 90% to 100% of each rockshelter site was completely excavated.

All fill was removed in 10-cm intervals until stratigraphic depositional units were identified, at which point the removal of fill proceeded by excavating each depositional unit as a stratigraphic level. All removed fill was screened through 1/4" mesh hardware cloth, and all artifacts recovered were bagged for analysis.

The decision to collect pollen, flotation, and carbon samples was conditioned by the degree of disturbance caused by rodent activity, which was evident in all of the rockshelters. Samples were collected from stratigraphic profiles only where undisturbed contexts were present. The location of collected samples was then indicated on the plan and profile map drawn for each rockshelter. Lastly, black-and-white and color photographs were taken of each excavated feature.

Site 42Ws1828 consists of seven hearths scattered about the lower ridge slope below the rockshelters. These small features were investigated by setting up appropriate 1-m by 1-m contiguous excavation units over the feature, then carefully stripping and screening the surface soil to expose the feature outline, and to recover a sample of artifacts from the immediate area around each feature. The feature was then excavated by removing a cross-section of the fill, leaving a profile of the interior fill. The profile was then drawn, sampled for pollen, flotation, and carbon remains, and several photographs were taken. Finally, the remainder of the fill was excavated, final map plans were drawn, and final photographs taken.

Analytic Methodology

The site descriptions which follow are organized to provide answers to the research problem domains at the site-specific level; that is, each rockshelter or exterior feature is treated as an arbitrarily defined unit of occupation. These individual synchronic site descriptions form the basis for addressing research questions relevant to the regional, diachronic "community" level of prehistoric adaptation in the St. George Basin. Hence,

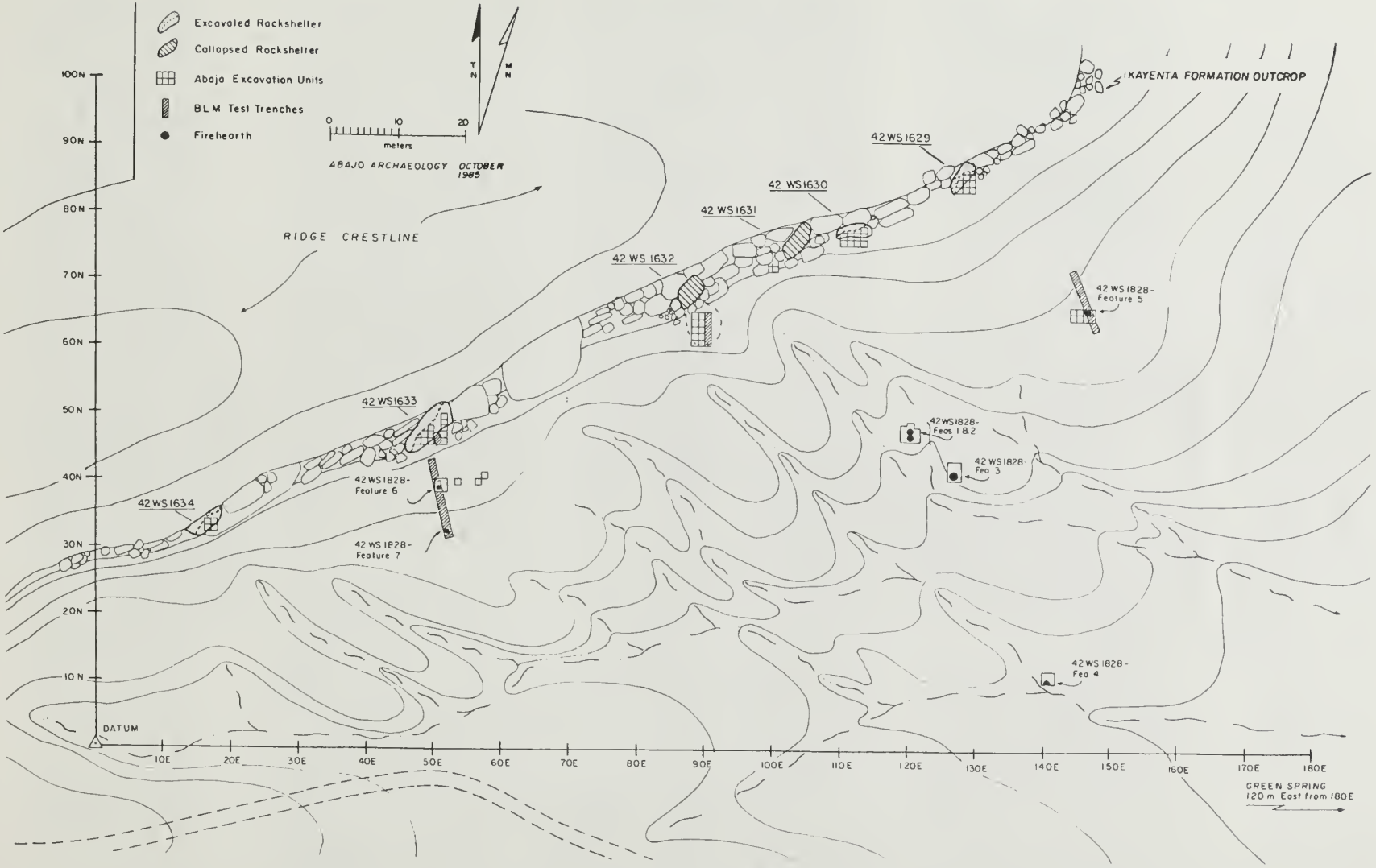


FIGURE 4.1. Washington City-Green Spring Archaeological Project: Excavation Plan Map.

following a basic description of each site, the excavated data are subsumed under the five research problem domains: chronology and cultural affiliation, subsistence, technology, exchange, and logistical organization. These draw on the results of specialized analyses which are presented in subsequent chapters and appendices in this report. In order to avoid undue repetition only basic data are presented in this chapter, and the reader is referred to the specific analytic chapters and appendices for more detailed information.

Site Descriptions

Site 42Ws1629

Introduction

Site 42Ws1629 is the easternmost of the six rockshelters. Previous investigations by the BLM archaeologists at this site consisted of excavating a 1-m by 13-m north-south test trench at the base of the ridge slope directly below the rockshelter (Dalley 1984). This resulted in the discovery of a charcoal-stained soil and rock concentration, designated BLM Feature 3, which has since been renamed 42Ws1828-Feature 5. A complete surface collection of the artifacts on the slope also was made at this time. The deposits within the rockshelter itself had not been tested.

Description

The rockshelter is a low, shallow concavity extending 1.2 m high above the modern ground surface, 4.0 m wide across the mouth, and 2.8 m to the back wall from the dripline. The bedrock floor is 0.30 m below the modern interior ground surface. A relatively recent low wall constructed of 2 to 3 courses of unmortared, unshaped tabular sandstone rocks extends partially across the western mouth of the alcove. The wall measures 1.7 m long (east-west), 0.38 m wide, and 0.23 m high (Figures 4.2 and 4.3).

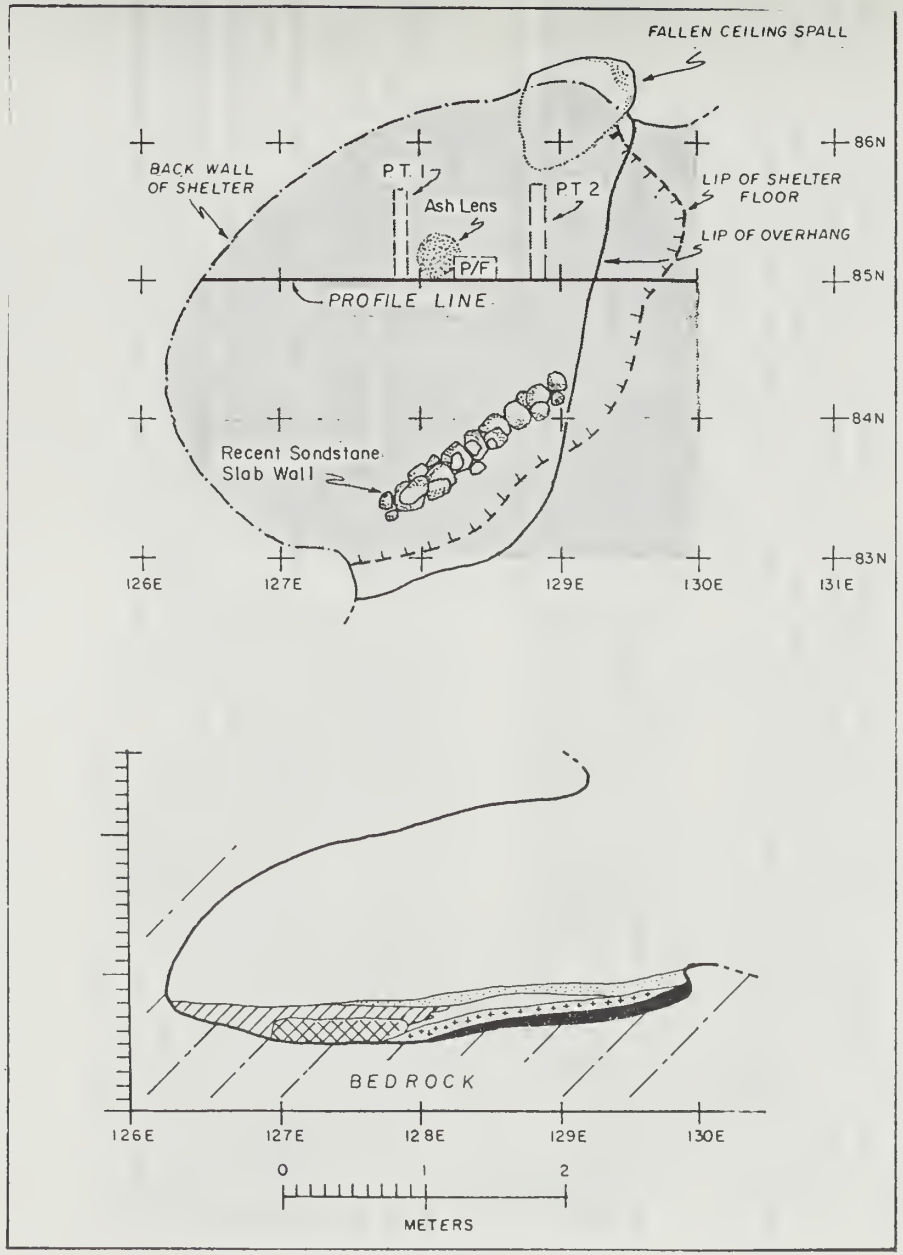
The investigation of Feature 1 was initiated by excavating a 1-m by 3.5-m east-west trench through the center of the rockshelter fill down to bedrock to evaluate the subsurface stratigraphy. After drawing and sampling the trench profile, the remainder of the fill was excavated in 1-m by 1-m units in order to control for spatial patterning in artifact deposition. A total of thirteen 1-m by 1-m units were excavated.

Stratigraphy

The fill of the rockshelter ranged in thickness from 10 cm at the back wall to 30 cm in the center. The western half of the fill (the "back half" of the shelter) had been previously dug out and refilled with mixed eolian sand, sandstone roof spalls, charcoal flecks, and artifacts. This section also had been further mixed by rodent burrowing (Strata E and F). In contrast, the eastern, front section of the rockshelter fill appears to have been left relatively intact, where four stratigraphic units were identified. These are designated Strata A, B, C, and D, and were sampled for pollen and flotation analyses (Figure 4.4).

FIGURE 4.2. 42Ws1629: General overview of rockshelter prior to excavation, view north. Note low rock wall across mouth of alcove.

FIGURE 4.3. 42Ws1629: General post-excavation overview of rockshelter.



42 WS1629: Plan and Profile Key

A — Fine, orange-brown eolian silt with small twigs and sandstone inclusions.

B — Loose, orange-brown eolian silt with sparse charcoal flecks, artifacts, and sandstone spalls.

C — Mixed cultural and post-abandonment debris mottled, gray-brown, loose silt with charcoal flecks, artifacts, and burned sandstone rocks.

D — Ashy gray silt with charcoal flecks and artifacts

E — Similar to Stratum B, except has looser texture.

F — Rodent disturbance

Excavation Units

P.T. Floor Pollen Transects

P/F Pollen/Flotation Sample Column

FIGURE 4.4. 42Ws1629, Plan and profile map.

The results of the archaeobotanical and artifactual analyses indicate that the four stratigraphic units in the western rockshelter fill may be related to three occupational episodes. The lowermost Stratum D and bedrock floor of the rockshelter represents the earliest episode of use, possibly by a Pueblo I period Virgin Anasazi group. Stratum C reflects a period of relatively light usage by the Pueblo II Virgin Anasazi, and Strata B and A are associated with a relatively intensive Southern Paiute occupation.

Chronology and Cultural Affiliation

Dating the sequence of occupation at 42Ws1629 is dependent on temporally diagnostic artifacts. The ceramic and lithic evidence indicates three occupations. The earliest period is represented by a relatively high frequency of plain jar rim sherds in the Virgin Series assemblage, and non-corrugated Moapa Gray Ware and Shinarump Gray Ware (see Blinman, Chapter V). These indicate an A.D. 900-1050 Pueblo I period of use. A subsequent Pueblo II occupation is indicated by relatively high percentages of Virgin Series decorated whitewares (e.g., North Creek Black-on-gray: Dogoszhi style) and Shinarump Corrugated Gray Ware. Lastly, a Southern Paiute occupation is indicated by a great number of Southern Paiute Utility Ware sherds, and the presence of Eastgate Expanding Stem, Desert Side-notched, and Cottonwood Triangular projectile points. These projectile points post-date A.D. 1000 and are known to have continued into the historic period in Southern Paiute contexts (Fowler, Madsen and Hattori 1973).

Subsistence Data

Four pollen samples and three flotation samples from the fill of the rockshelter were submitted for analysis. The site is distinguished from the other rockshelters by the greatest variety of economic plant species and a substantial assemblage of large game animal bones (Hevly and Edwards, Appendix A; Mead, Appendix B).

Economically significant plant species represented in the total pollen and flotation samples include Agave/Yucca, Ephedra, Artemisia, Opuntia, Echinocereus, Prosopis, Rhus, Brassicaceae sp., Cheno-ams, and Allium. Burned bones of Odocoileus, Ovis canadensis, Sylvilagus, and Lepus represent hunted faunal species. Bones of other animals, such as Neotoma were also recovered, but since these were not burned it is uncertain if they constituted human dietary items.

While this listing shows the kinds of plants and animals available to the site inhabitants, selective emphases are apparent with respect to the three different occupational episodes represented by Strata D-Floor, Stratum C, and Strata A-B, respectively. Strata D-Floor contained the pollen of Agave, Rhus, Opuntia, Allium, Cyperaceae, Juncus, and Typha, representing upland, low desert, and aquatic plants. These indicate that the Pueblo I Virgin Anasazi availed themselves of a relatively wide-ranging catchment area, and that occupation of the rockshelter probably extended from spring, through summer, to early fall. Only a few burned scraps of unidentifiable mammal bones were recovered from Strata D-Floor, so specific hunting emphases are not known for this temporal unit.

The pollen spectrum from Stratum C, representing a Pueblo II Virgin Anasazi occupation, exhibits one upland species, Rhus, and only a few low desert plants. Moreover, no faunal bone was recovered from this stratum. Hence, it appears that subsistence-related activities during this time period exploited a relatively restricted resource catchment area, perhaps during the summer season.

Lastly, Strata A and B, representing a Southern Paiute occupation, exhibit pollen spectra similar to that from Stratum D-Floor, implying once again the use of a relatively wide-ranging resource catchment area. Moreover, Strata A and B yielded numerous burned bones of Odocoileus, Ovis canadensis, Sylvilagus, and Lepus, which indicate hunting of both upland and low desert animals. Collectively, these data suggest an occupation spanning spring, summer, and early fall.

Material Culture

The testing and excavation of 42Wsl629 yielded a total of 799 ceramic sherds, the largest collection of all the rockshelters (Blinman, Chapter V). The total assemblage was dominated by Southern Paiute Utility Ware (n=491; 61.5%), followed by Tusayan Gray and White Wares: Virgin Series (n-159; 19.8%), Shinarump Gray Ware (n=121; 15.1%), Moapa Gray Ware (n=21; 2.6%), Emery Gray (a Fremont type)(n=6; 0.7%), and an unidentified grayware sherd (n=1; 0.1%).

The earlier Pueblo I occupation is characterized by a dominance of Virgin Series and Moapa wares and a lower frequency of Shinarump wares. Moreover, there is a relatively close ratio of bowls to jars, implying generalized food gathering, preparation, and consumption, thought to be associated with a long-term residential camp during the Pueblo I period of occupation. In contrast, the subsequent Pueblo II occupation is characterized by an increase in Shinarump wares, and by a higher ratio of jars to bowls. This is thought to indicate a narrowing down of site activities towards more specialized, short-term resource gathering. Lastly, the Southern Paiute ceramic assemblage is characterized by both jar and bowl forms, the jars being further distinguished by relatively wide orifices. These attributes imply the use of wide-mouthed jars primarily for cooking, rather than for storage purposes, and the close ratio of bowl-to-jar forms again implies extended camping (see Blinman, Chapter V).

A total of 121 lithic artifacts were recovered from 42Wsl629 (Table 4.1; see Chapter VI). The majority of lithic artifacts were recovered from Strata A, B, D, and the ridge slope surface below the rockshelter. The range of lithic artifact types indicates a variable range of activities: tool manufacture and maintenance, hunting, butchering, hide-working, and rendering of various plant parts. The milling stone assemblage includes three manos and two grinding slabs, all in fragmentary condition, but which retain sufficient attributes to demonstrate a relatively high degree of variability in raw material composition and form. These characteristics imply that the grinding tools were used to process a relatively wide variety of resources.

TABLE 4.1. 42Ws1629: Lithic Artifact Summary.

Artifact Type	Frequency
Projectile Point: Elko Series	1
Projectile Point: Numic types	3
Projectile Point: Other/Unknown	0
Biface/Knife	3
Unifacial Scraper	1
Retouched Flake Tool	0
Utilized Flake	2
Graver/Perforator	1
Wedge	0
Denticulate	0
Abraded Cobble Tool	1
Hammerstone	2
Hammerstone Resharpening Flake	1
Grooved Abrader	0
Mano	3
Grinding Slab	2
Core	1
Debitage	100
TOTAL	121

The lithic tool assemblage recovered from 42Ws1629 appears to be associated primarily with the Southern Paiute occupation of the rockshelter. It is probable that originally some tools may have been part of a Virgin Anasazi tool kit re-used by the Southern Paiute, but this cannot be confirmed. Be that as it may, the variety of tool forms and the corresponding archaeobotanical variation are consistent with the expectations for a residential camp assemblage for the Pueblo I Virgin Anasazi and Southern Paiute occupations, and as a specialized resource collecting locality in the Pueblo II period.

Exchange

Assuming that the different ceramic wares recovered from 42Ws1629 were manufactured at different localities, the presence of Moapa and Shinarump wares indicates ceramic exchange with groups to the south (Moapa) and to the east (Shinarump). The recovery of sherds tentatively identified as Emery Gray indicates possible exchange with Fremont groups to the north. Another indicator of exchange is the presence of obsidian derived from a source near Modena, Utah (Chapter VI).

The presence of these items at 42Ws1629 supports the assumption that seasonally transhumant groups were more likely to have participated in exchange systems with other mobile groups, thus resulting in the deposition of mixed

ceramic assemblages and exotic lithic materials at a site. This assumption is further supported by a comparison of the 42Ws1629 artifact assemblage with that from the Red Cliffs Site, a Pueblo I-II Virgin Anasazi village located 10 miles northeast of Green Spring (Dalley and McFadden 1985). At the Red Cliffs Site, Virgin Series ceramics predominate, while Moapa and Shinarump wares are only minimally represented. Moreover, obsidian also was scarce at the Red Cliffs Site (Dalley and McFadden 1986:110, 142-155). Hence, it is likely that the prehistoric groups who occupied 42Ws1629 as a residential base during the Pueblo I and Southern Paiute periods followed a basic pattern of seasonal transhumance between the St. George Basin and the surrounding uplands. Groups who used the site during the Pueblo II period may have most likely been affiliated with a permanent village settlement located elsewhere in the near vicinity of Green Spring.

Lastly, the recovery of several pre-1900s .22 Long and Short rifle cartridges and a .44-40 cartridge (Chapter VII) might indicate exchange between historic Southern Paiute and Anglo-American groups.

Logistical Organization

The chronological evidence from 42Ws1629 indicates that the rockshelter was used on several occasions by Virgin Anasazi groups during the Pueblo I and Pueblo II periods, and by the Southern Paiute some time later. Subsistence and material culture data indicate that resource procurement and processing tasks varied over time, and also reflect the logistical organization of different group mobility strategies.

During the Pueblo I period, the rockshelter functioned as a residential base for Virgin Anasazi foraging groups during the spring, summer, and fall. These groups may have followed a pattern of seasonal transhumance, as indicated by the presence of Moapa Gray Ware pottery probably obtained by exchange. In the Pueblo II period, specialized task groups ("collectors") may have used the rockshelter only for short-term procurement and processing of resources, which were then either consumed on-site, or transported back to a residential base located elsewhere. Lastly, the rockshelter was used once again as a residential base by the Southern Paiute; subsistence and material culture data clearly indicate an eclectic foraging strategy that focused on a relatively wide-ranging resource catchment area during the spring, summer, and early fall.

Site 42Ws1630

Introduction

Site 42Ws1630 is situated 18 meters west of 42Ws1629. The site was originally recorded as a shallow rockshelter with a stained soil deposit to the front (south). A light scatter of lithic debitage flakes and ceramic sherds occurred on the surface of the stained area, and cultural depth was estimated to be 20 cm. This site was not tested prior to the excavation project (Dalley 1984).

Description

The rockshelter is a detached, mushroom-shaped erosional feature of the Kayenta Formation, which rises above a concave bedrock ledge (Figure 4.5). This rockshelter was the only one of the seven which contained an interior feature, a roasting pit (Feature 1) (Figure 4.6). The ceiling extends 1.30 m above the modern ground surface, and 1.50 m above the original bedrock floor. The mouth of the shelter extends 3.90 m east-west, and the available shelter space extends 1.00 m from the roof dripline to the back wall.

The investigation of 42Ws1630 commenced by excavating a 1-m north-south by 5-m east-west exploratory trench in 1 meter units across the front of the rockshelter in order to profile the stained soil unit. This trench was subsequently expanded towards the back wall by removing the fill in contiguous 1-m by-1 m units. A total of seventeen 1-m by 1-m units were excavated to recover data from 42Ws1630 (Figure 4.7).

Stratigraphy

The fill of 42Ws1630 ranged in thickness from 3.0 cm at the back wall to 42.0 cm at the center of the concave bedrock floor. Three stratigraphic units and an intrusive roasting pit (Feature 1) were defined (Figure 4.7). Stratum A of the rockshelter fill consisted of recent loose eolian sand with charcoal flecks and ranged from 3.0 to 5.0 cm thick. Stratum A overlaid Stratum B in the western section, and over Stratum C in the eastern section of the rockshelter. Stratum B had been mixed by rodent burrowing, and consisted of loose eolian and water-deposited sand, sandstone spalls, charcoal pieces, and Virgin Anasazi ceramics. A large spall from the shelter roof had collapsed onto Stratum B in the western section of the rockshelter fill, effectively sealing it off from the subsequent intrusion of Feature 1 in the eastern section. Stratum C, the matrix into which Feature 1 was excavated, consisted of loose, gray-stained, powdery sand containing a moderate abundance of charcoal pieces, smudged sandstone rocks (debris from Feature 1), and sparse artifacts.

Feature 1

Feature 1 is a large rock-filled roasting pit (Figures 4.8 and 4.9), formed by simply scooping a large basin out of the loose fill of Stratum C. The basin lacked well-prepared or hard-packed interior surfaces and was not lined. The basin measures 0.95 m north-south, 1.25 m east-west, and 0.28 m deep. The interior fill consisted of two distinct depositional units. The uppermost unit was a 20-cm thick lenticular concentration of burned and smudged sandstone rocks, intermixed with charcoal-stained eolian sand, charcoal flecks, and ash lenses. This overlaid a 10 to 12-cm thick lens of powdered charcoal and charcoal pieces. A few lithic artifacts were recovered from the upper rock-filled unit, and a single sherd of Southern Paiute Utility Ware was recovered from the lower charcoal unit.

FIGURE 4.5. 42Ws1630: Overview of rockshelter after excavation, view north.

FIGURE 4.6. 42Ws1630: Feature 1 (roasting pit) with smudged rocks in center of feature.

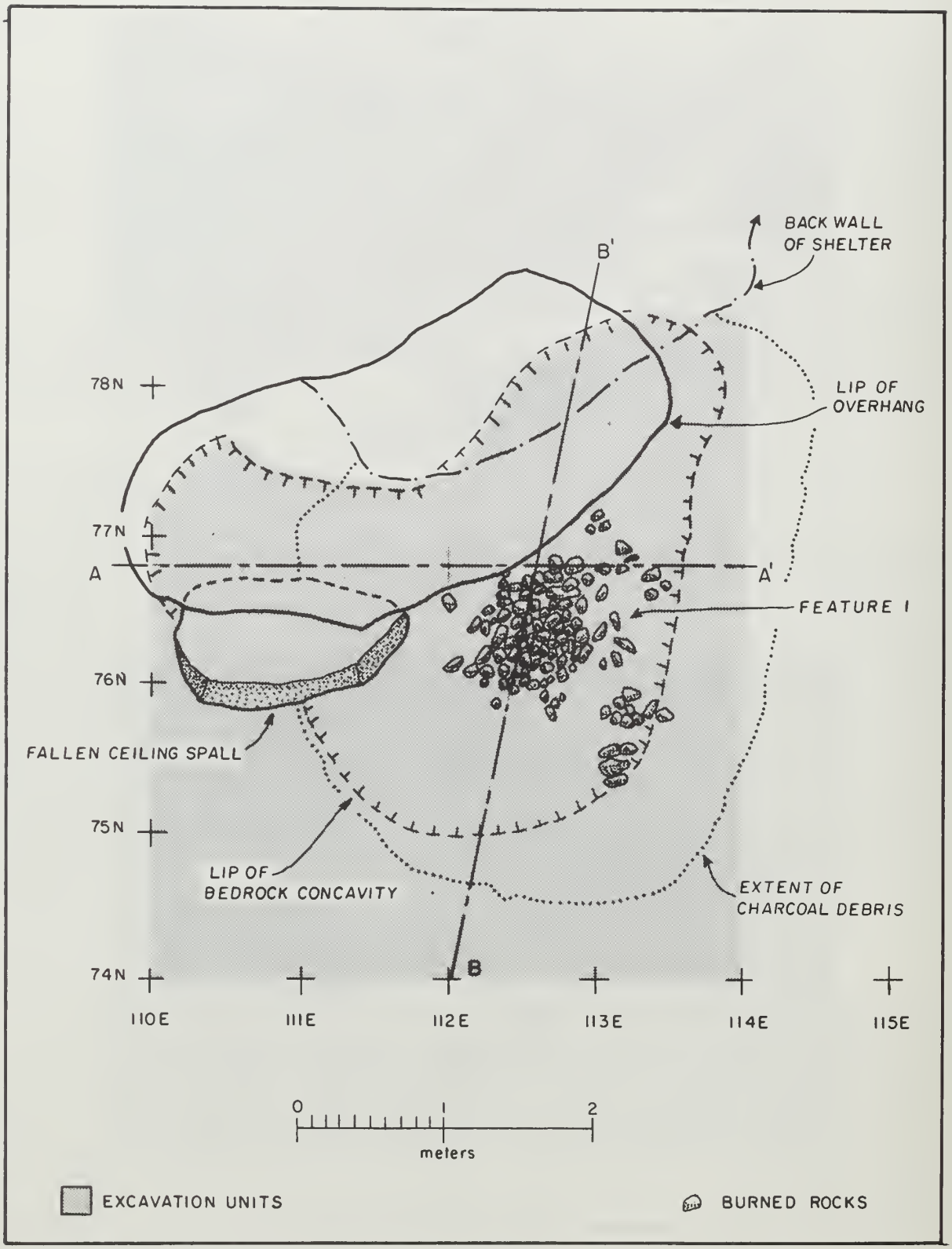


FIGURE 4.7. 42Ws1630: excavation plan map.

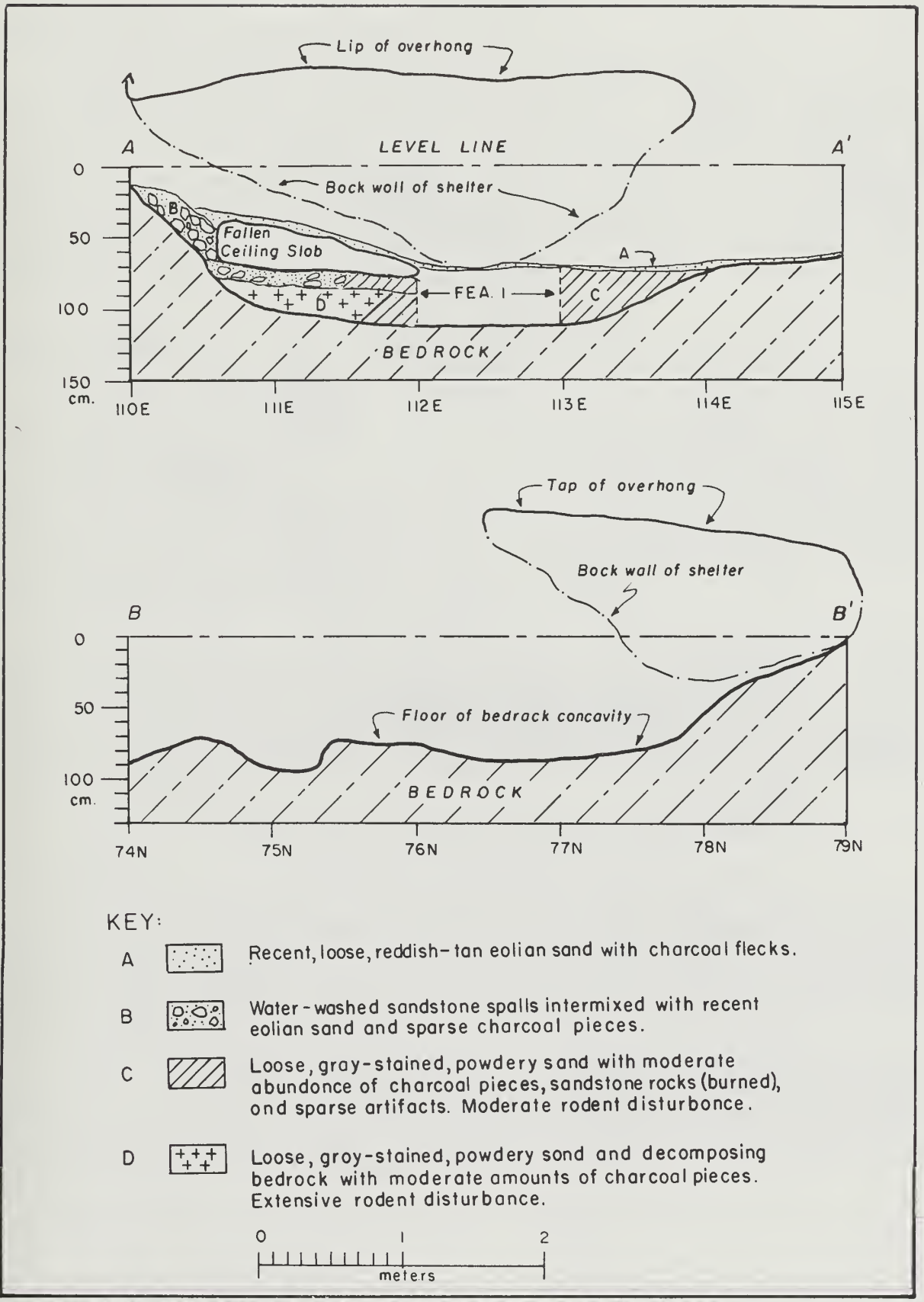


FIGURE 4.8. 42Ws1630: Profile of rockshelter fill (top) and final rockshelter profile map (bottom).

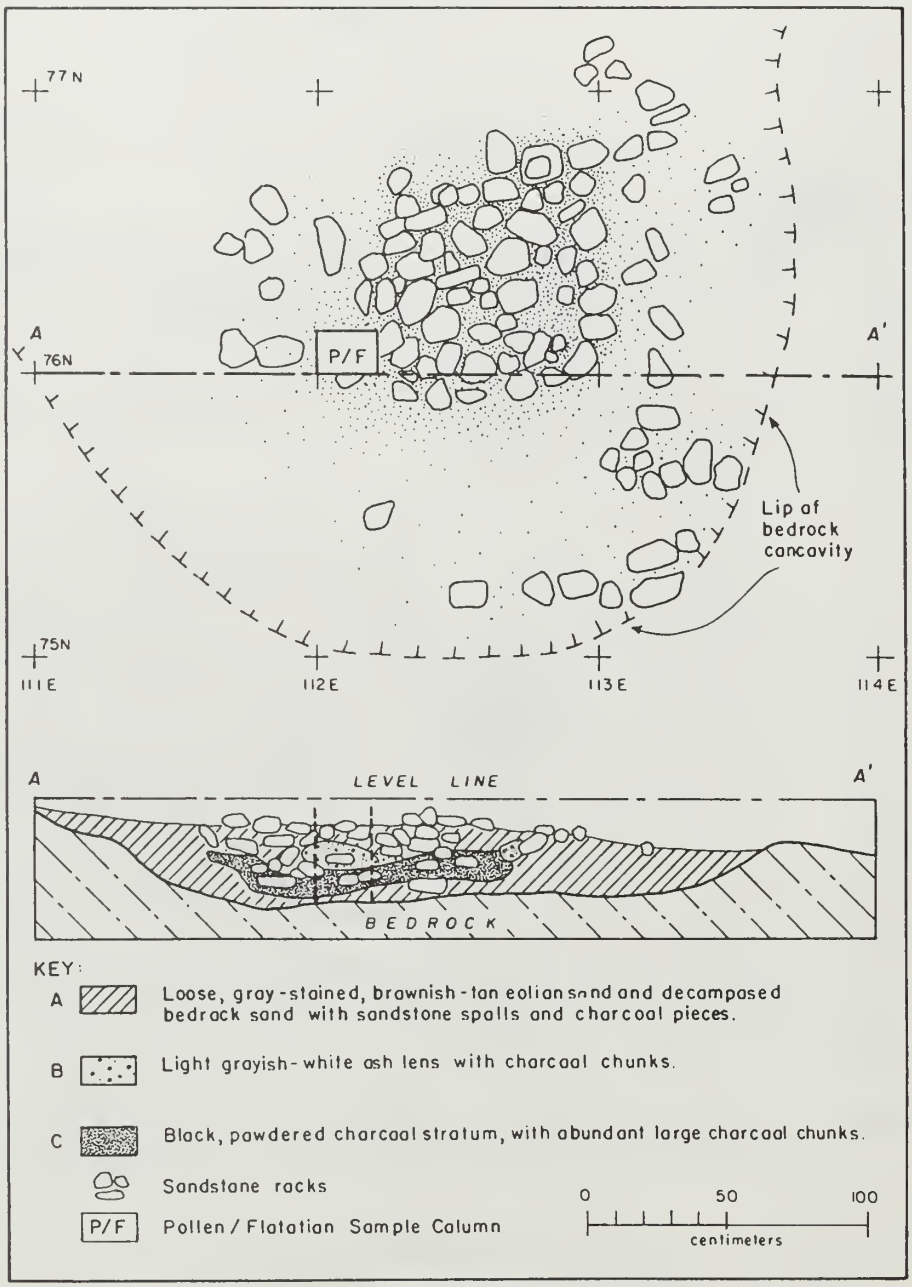


FIGURE 4.9. 42Ws1630: Feature 1 (roasting pit) plan and profile map.

Chronology and Cultural Affiliation

A sample of charcoal from Feature 1 yielded a "Modern" radiocarbon date, suggesting use of the roasting pit during A.D. 1850-1950. This time span is consistent with the known historic Southern Paiute occupation of southwest Utah (ca. A.D. 1100-1904), and is supported by the recovery of Southern Paiute Utility Ware ceramics from Feature 1 and its immediate vicinity. An earlier Pueblo II Virgin Anasazi occupation (ca. A.D. 900-1050) is indicated by the presence of St. George Black-on-gray: Black Mesa style ceramics recovered from Stratum B in the western section of the rockshelter (see Blinman, Chapter V).

Subsistence Data

Three pollen samples and three flotation samples collected from Feature 1 were submitted for analysis. The pollen spectra revealed a relatively restricted range of economic plant species, including Salix, Cyperaceae sp., Artemisia, Ephedra, Brassicaceae sp., Poaceae sp., and Cheno-ams. Charred plant specimens recovered in flotation included a burned Cercocarpus leaf, and a burned Opuntia spine. Lastly, plant materials recovered in the screen included a Euphorbiaceae sp. seed, an Opuntia seed, and several cut bunches of Stipa speciosa, although these were not burned. Two unidentified, unburned mammal bone scraps also were recovered.

The cut bunches of Stipa speciosa are associated with the Pueblo II Virgin Anasazi occupation of the rockshelter. The archaeobotanical data indicate the possible use of Feature 1 as a roasting pit (for Opuntia fruit) and/or as a hearth into which a pottery vessel may have been placed for boiling plant parts (e.g., seeds and fruit) (cf. Heizer 1954:6). If Opuntia indeed was the resource emphasis, then a late summer occupation by the Southern Paiute is implied.

Material Culture

The excavation of 42Ws1630 yielded 43 ceramic sherds (see Blinman, Chapter V), including Tusayan Gray and White Wares: Virgin Series (n=28; 65.1%), followed by Southern Paitue Utility Ware (n=8; 18.6%), and Shinarump Gray Ware (n=7; 16.3%). The close ratio of bowls (n=11) and jars (n=18) indicates food gathering, cooking, and consumption associated with short-term camp activities.

A total of 46 lithic artifacts were recovered, of which 12 are tools (Table 4.2; Chapter VI). The majority of these were recovered from Strata A and C, and are most likely associated with the Southern Paiute occupation. The artifacts indicate limited hunting, hide-working, plant processing, and tool manufacture and maintenance activities.

TABLE 4.2. 42Ws1630 Lithic Artifact Summary.

Artifact Type	Frequency
Projectile Point: Elko Series	0
Projectile Point: Numic types	1
Projectile Point: Other/Unknown*	1
Biface/Knife	2
Unifacial Scraper	1
Retouched Flake Tool	0
Utilized Flake	2
Graver/Perforator	1
Wedge	0
Denticulate	0
Abraded Cobble Tool	1
Hammerstone	1
Hammerstone Resharpening Flake	0
Grooved Abrader	0
Mano	1
Grinding Slab	0
Core	1
Debitage	34
TOTAL	46

*Cottonwood Triangular

Exchange

The Virgin Anasazi ceramic assemblage is dominated by Virgin Series wares, with a low number of Shinarump wares and no Moapa wares (Blinman, Chapter V). If Virgin Series ceramics are assumed to represent the "local" pottery, the ceramic assemblage indicates use of the site by a group of plant resource collectors from a residential base located elsewhere. Limited exchange with more easterly Anasazi groups is suggested by the low number of Shinarump wares.

Obsidian from the Modena, Utah, area was recovered from this site, and is believed to be associated with the Southern Paiute occupation (Chapter VI). As at 42Ws1629, it is likely that the Southern Paiute who occupied 42Ws1630 also obtained obsidian by means of exchange during the course of seasonal group movements between the St. George Basin and the northwestern uplands. Lastly, limited exchange between the historic Southern Paiute and Anglo-Americans might be indicated by the recovery of one .22 Long rifle cartridge (Chapter VII).

Logistical Organization

The cumulative evidence shows that 42Ws1630 was occupied by the Virgin Anasazi during the Pueblo II period and by the Southern Paiute during the historic period. Both cultural groups may have used the rockshelter primarily for specialized plant resource procurement and processing, as indicated by the limited variety of economic plant species in the botanical record and by the absence of faunal bone.

Site 42Ws1631

Introduction

Site 42Ws1631, the third rockshelter, is situated 9 meters west of 42Ws1630. The original bedrock overhang forming the roof of the rockshelter had collapsed, leaving only a small area of cultural debris on the ledge south of the shelter. The collapsed bedrock section effectively sealed off an area 11 m east-west by 3 m north-south, which was not accessible for investigation. This rockshelter was not investigated during the BLM testing program.

A 1-m by 1-m unit was excavated in the small area of stained soil abutting the basal edge of the collapsed sandstone. This unit was subsequently expanded to the north and west to recover the entire remaining cultural deposits as far as was feasible (Figures 4.10 and 4.11).

FIGURE 4.10. 42Ws1631: Excavation Unit 72N, 100E at base of collapsed rockshelter roof, view north.

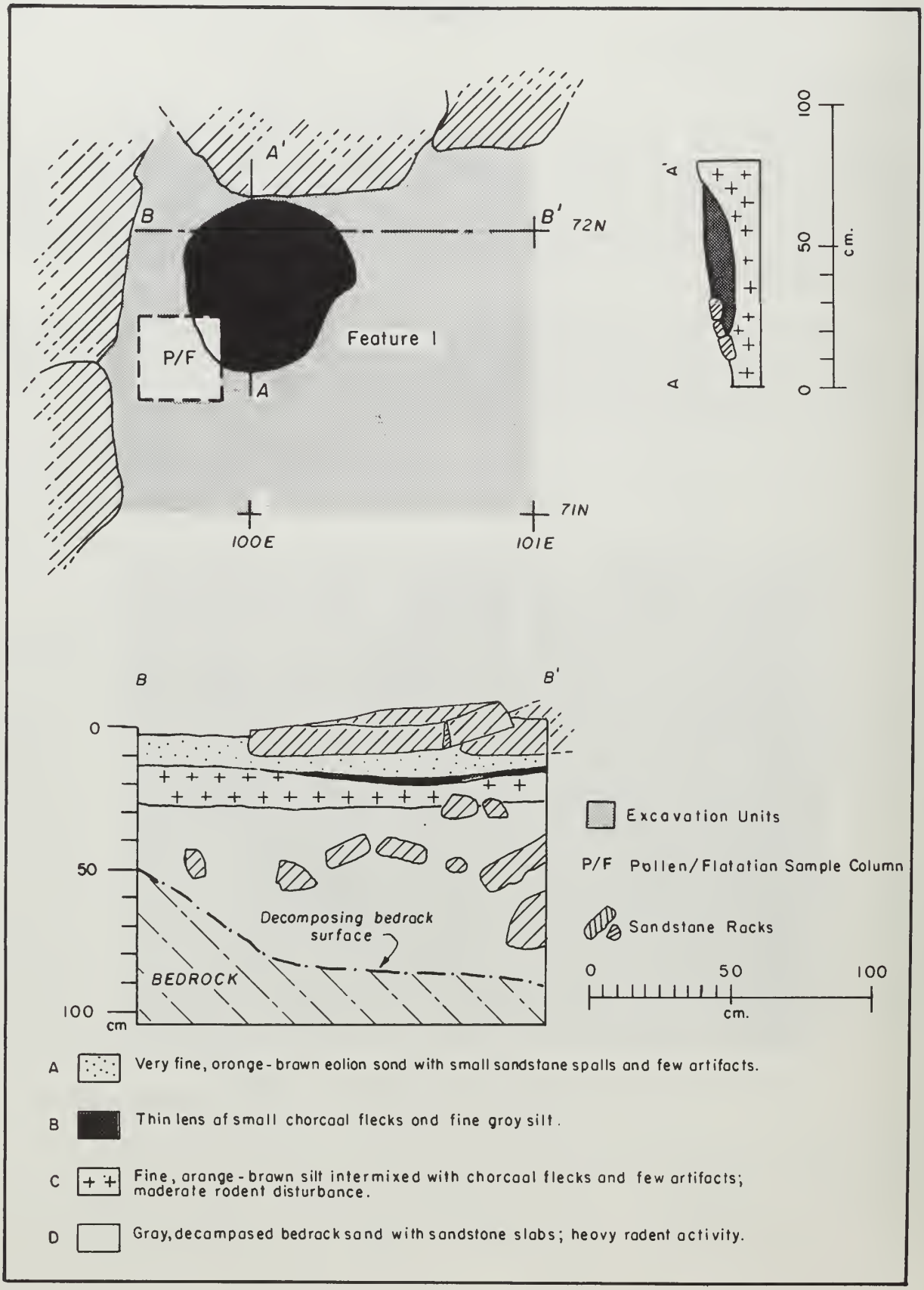


FIGURE 4.11. 42Ws1631: Plan and profile maps of excavation units.

Stratigraphy

Four stratigraphic units were defined in the excavation unit. Stratum A was a deposit of recent fine, orange-brown eolian sand with small sandstone spalls and a few surface artifacts. Stratum B was a lens of dark gray-stained silt with charcoal flecks 50 cm long (east-west) and 10 cm thick. The lens is believed to represent a deposit of firehearth residue discarded from a hearth used elsewhere, since there was no evidence of in situ primary burning. Stratum C was a fine, orange-brown silt with charcoal flecks, exhibiting minor rodent disturbance. It is apparent that deflation and rodent burrowing contributed to the scattering of charcoal from Stratum B to Stratum C. Stratum D was a sterile unit of decomposed bedrock sand and sandstone slabs resting on decomposing Kayenta Formation sandstone. The bedrock surface was riddled with rodent burrows.

Chronology and Cultural Affiliation

A sample of charcoal collected from the charcoal lens yielded a "Modern" radiocarbon date (ca. A.D. 1850-1950). Diagnostic artifacts recovered from the excavation unit include Tusayan Gray Ware: Virgin Series, Shinarump Gray Ware, and Southern Paiute Utility Ware. The Virgin Anasazi ceramics indicate a late Pueblo II period occupation, while the Southern Paiute wares may be associated with a re-occupation of the site by the Southern Paiute in the historic period (see Blinman, Chapter V).

Subsistence Data

One pollen sample and one flotation sample were collected from the charcoal lens for analysis. Economic species represented in the pollen spectra are: Ephedra, Artemisia, Poacaceae sp., Cheno-ams, Opuntia, and Zea. This site is one of only two rockshelters with evidence of Zea. No macrofloral specimens were identified in the flotation sample (Hevly and Edwards, Appendix A). No faunal bone was found.

These data indicate a relatively restricted range of plant species. The presence of Opuntia indicates a late summer use of the site. The presence of Zea at the very least indicates that the site inhabitants had access to corn, which could either have been carried in to the site or grown nearby. Without substantive supporting data from the unexcavated portion of 42Ws1631, the significance of Zea at this site remains problematic.

Material Culture

A total of 43 ceramic sherds were recovered from the excavation unit at 42Ws1631 consisting of Southern Paiute Utility Ware (n=19; 65.5%), Shinarump Gray Ware (n=7; 24.1%), and Tusayan Gray Ware: Virgin Series (n=3; 10.3%). The Anasazi ceramics include jar body sherds (n=8; 80%), a bowl rim sherd (n=1; 10%), and one sherd (10%) which could be from either a jar or bowl. However, these relative vessel form frequencies cannot be used to evaluate site function, since only a very small portion of the site was excavated.

Nineteen lithic artifacts were recovered from the excavation unit including 2 utilized flakes, 1 wedge, 1 abraded cobble tool, 1 hammerstone, and 14 pieces of debitage (Chapter VI). These are relatively expedient tools used for generalized resource processing activities. Again, the small sample precludes confident statements about site function.

Exchange

The presence of Shinarump Gray Ware in the ceramic assemblage denotes Virgin Anasazi exchange with easterly groups during the late Pueblo II period. The recovery of obsidian debitage might indicate either Virgin Anasazi or Southern Paiute exchange; however, source analysis was not conducted on the material to verify this.

Logistical Organization

Since only a small portion of Site 42Ws1631 could be investigated, it is not possible to confidently identify the range of activities conducted at this site. The material culture assemblage reflects generalized collecting and processing tasks, but it is not possible to ascertain whether these were associated with a residential camp or with a short-term camp.

Site 42Ws1632

Introduction

Site 42Ws1632 is a second collapsed rockshelter, situated 17 meters west of 42Ws1631. The site was tested by excavating a 1-m east-west by 10-m north-south trench from the base of the collapsed rock face south down the ridge slope below. The testing results revealed 40 to 50 cm of artifact deposition, scattered charcoal pieces, and a general dark-stained soil near the bedrock face (Dalley 1984).

The investigation of 42Ws1632 consisted of excavating a series of parallel 1-meter-wide trenches extending north-south from the fallen rock face down the slope. The trenches were excavated in 1 meter units in an effort to control for spatial patterning in artifact distribution. This was done to evaluate the preliminary assessment of the site, in which it was felt that the cultural deposit represented an in situ occupation abutting the rock face (Dalley 1984). Ten 1-m by 1-m units were excavated. Combined with the BLM test trench, a total of 15 units altogether were excavated to recover data (Figure 4.12).

Stratigraphy

As shown in profile (Figure 4.13), the ridge slope is formed by an irregular Kayenta Formation bedrock configuration. Overlying the bedrock are mass quantities of rock fall which, combined with fluvial event erosion and eolian deposition, have produced a mixed depositional profile. Although disturbance by animals has been minimal, disruption by roots has been considerable, further contributing to contextual displacement.

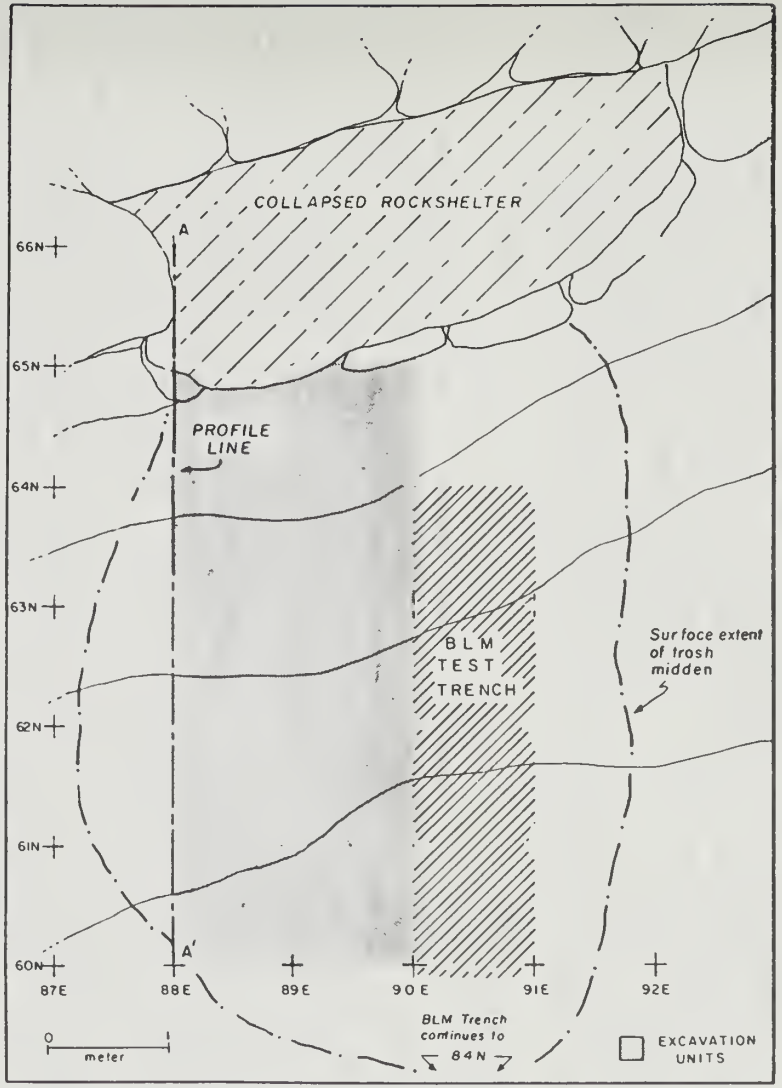


FIGURE 4.12. 42Ws1632: Excavation plan map.

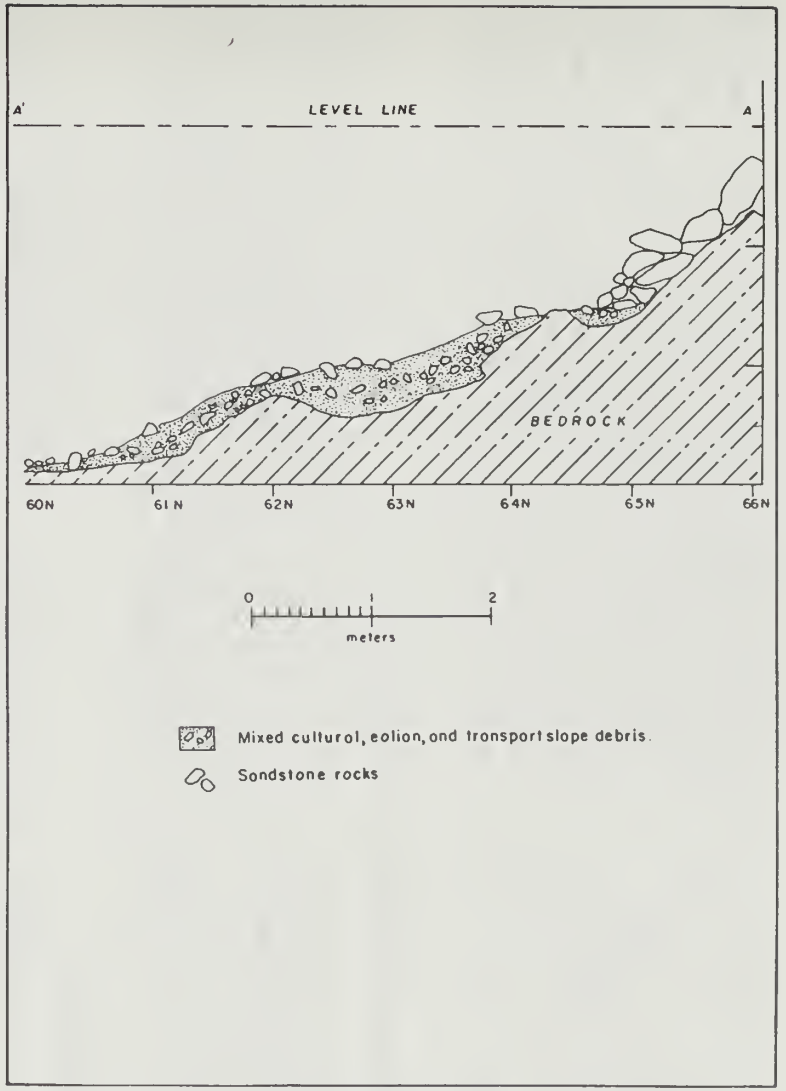


FIGURE 4.13. 42Ws1632: Profile of transport slope and trash midden.

The excavation of soil deposits overlying the bedrock transport slope failed to verify an in situ occupation, and no features (e.g., hearths) were found. The presence of charcoal flecks and evidence of soil staining is probably the result of redeposition of hearth contents onto the trash midden on the ridge slope. Relative to the other sites, 42Ws1632 yielded the second highest frequency of ceramic sherds and lithic artifacts, and the artifact assemblage is most similar to that from 42Ws1629. The presence of charcoal, the relative high frequency of material culture items, and location on a ridge slope directly below a collapsed rockshelter, are attributes indicating a trash midden, probably associated with a residential camp now buried below the large collapsed rockshelter roof.

Chronology and Cultural Affiliation

Due to the mixed condition of the cultural deposits, carbon samples were not submitted for radiocarbon assay. Diagnostic ceramics include Tusayan Gray and White Ware: Virgin Series, Shinarump Gray Ware, Moapa Gray Ware, Tsegi Orange Ware (a Kayenta Anasazi type), and Southern Paiute Utility Ware. These indicate occupation of the site by the Virgin Anasazi during the Pueblo I and Pueblo II periods, and by the Southern Paiute during the historic period (see Blinman, Chapter V).

Subsistence Data

One pollen sample was collected and submitted for analysis. Economic species represented in the pollen spectra included Cyperaceae sp., Yucca, Ephedra, Opuntia, Prospis, Artemisia, Poacaceae sp., and Cheno-ams. Yucca may have been obtained from higher-elevation localities in the near distance while the other species were probably growing nearby. This sample also had the highest percentage of Cheno-am pollen (46%) of all the samples, including the modern sample. High frequencies of Cheno-am pollen are to be expected for disturbed, organically-rich areas such as trash middens, and also have been interpreted as cultivars acquired from nearby farm plots (cf. Lindsay 1981). No faunal bone was recovered from this site.

Material Culture

The 564 artifacts recovered from 42Ws1632 include 385 ceramic sherds and 179 lithic artifacts. The ceramic assemblage is dominated by Shinarump Gray Ware (n=178; 46.2%), followed by Southern Paiute Utility Ware (n=103; 26.7%), Tusayan Gray and White Wares: Virgin Series (n=91; 23.6%), Moapa Gray Ware (n=12; 3.1%), and one sherd (0.2%) of Tsegi Orange Ware (a Kayenta Anasazi type) was found (see Blinman, Chapter V). The Anasazi ceramic assemblage contains a high proportion of jars to bowls, indicating an emphasis on resource procurement and storage. The general abundance of ceramics relative to the other rockshelter assemblages indicates a series of repeated occupations or a long-term residential camp.

The lithic artifacts consist of 42 lithic tools and 137 pieces of debitage (Table 4.3; Chapter VI). This assemblage contains the greatest variety of tools, as well as the most numerous grinding implements. The tools indicate a wide range of resource procurement and processing tasks, with an emphasis

on plant processing. Of particular note is the occurrence of well-shaped, well-used manos and grinding slabs of vesicular basalt, which did not occur at any of the other rockshelter sites. The context of these artifacts, together with the archaeobotanical and ceramic evidence, may indicate a special focus on horticultural products at one time. The presence of Zea pollen at 42Ws1631, a contemporaneous site immediately east of 42Ws1632, also provides tentative support for this inference. Since neither rockshelter was accessible due to their collapsed roofs, this inference cannot be confirmed, although there is nothing to rule out the possibility of a nearby farm plot.

TABLE 4.3. 42Ws1632: Lithic Artifact Summary.

Artifact Type	Frequency
Projectile Point: Elko Series	0
Projectile Point: Numic types	3
Projectile Point: Other/Unknown	1
Biface/Knife	6
Unifacial Scraper	2
Retouched Flake Tool	2
Utilized Flake	5
Graver/Perforator	1
Wedge	3
Denticulate	0
Abraded Cobble Tool	1
Hammerstone	2
Hammerstone Resharpening Flake	6
Grooved Abrader	1
Mano	5
Grinding Slab	4
Core	1
Debitage	136
TOTAL	179

Exchange

The artifact assemblage from this site includes a number of exotic items consisting of obsidian derived from Modena, Utah, Shinarump and Moapa ceramics, and a sherd of Tsegi Orange Ware, derived from a vessel made in the Kayenta Anasazi region to the far southeast (see Chapters V and VI). The relative frequency of the diverse ceramic types indicates a greater incidence of exchange during the Pueblo II Virgin Anasazi period. This is consistent with the known pattern of Pueblo II period population expansion, which in turn may have fostered increased inter-group exchange.

Once again, as at 42Ws1629 and 1630, the presence of obsidian from Modena, Utah, at 42Ws1632 is believed to be associated with the Southern Paiute occupation. This indicates limited Southern Paiute exchange with other groups having access to lithic raw material sources situated northwest of the St. George Basin. Lastly, limited exchange between historic Southern Paiute and Anglo-American groups might be indicated by the recovery of one .22 Long rifle cartridge.

Logistical Organization

As with Site 42Ws1631, statements about the function of 42Ws1632 are tentative due to the incompleteness of the data base; however, the substantial trash midden indicates that 42Ws1632 functioned as a residential base camp during both the Virgin Anasazi and Southern Paiute occupations. These occupations may have been contemporaneous with the use of 42Ws1629, 1630, and 1631, although the sheer variety and abundance of material culture remains at 42Ws1632 indicates more intensive use of this site. The higher degree of occupational intensity may be related in part to an emphasis on horticultural subsistence, although this could not be confirmed by the available limited data.

Site 42Ws1633

Introduction

Site 42Ws1633 is the largest rockshelter and is centrally located in the Kayenta Formation outcrop. It was previously tested by Dalley and McFadden, who excavated a 50-cm deep 1-m by 4-m north-south trench into the center of the rockshelter (Dalley 1984). The trench yielded a number of Virgin Anasazi and Southern Paiute artifacts, historic artifacts, faunal bone, and dried vegetal material. A second 1-m by 12-m north-south test trench was excavated down the ridge slope below the rockshelter, exposing two near-surface hearths, one of which was excavated and the other left intact for future investigation. These two hearths were subsequently reclassed as Site 42Ws1828, Feature 6 and Feature 7, respectively.

Description

The rockshelter is formed by two large semi-detached sandstone blocks angled to form a high, vaulted ceiling above a small bedrock shelf (Figures 4.14 and 4.15). This shelf forms the western half of the rockshelter interior space and allows an overall living space measuring 5.0 m wide (east-west) at the mouth of the shelter, 4.7 m deep towards the back wall, and 3.0 m high. The eastern section of the interior is a steeply angled (68°) bedrock slope that extends 7.0 m to the back of the shelter. Prior to excavation the western shelf was overlain with a soil deposit ranging from 5 cm to 60 cm thick while the eastern interior bedrock slope was overlain by dense accumulation of sandstone ceiling spalls and packrat midden debris.

FIGURE 4.14. 42Ws1633: General overview of rockshelter, view to the northwest.

The western shelf was excavated in a series of 11 contiguous 1-m by 1-m units down to the bedrock floor. A 1-m by 5-m north-south trench was excavated in 1-m units in the eastern, sloping section. The results indicated that the western shelf comprised the primary area of material culture deposition, while the eastern section was characterized by abundant packrat midden debris, fallen rocks, and a few artifacts.

The investigation of 42Ws1633 resulted in the recovery of a diverse material culture assemblage which included portions of a human burial, a variety of prehistoric and historic artifacts, and abundant faunal bone.

Stratigraphy

Four stratigraphic units were defined within the rockshelter (Figure 4.15). Stratum A consisted of a thin veneer of recent light brown eolian silty sand occurring in variable patches throughout the shelter interior. Stratum B, present only in the eastern half of the shelter, consisted of undifferentiated mixed eolian sand, sandstone ceiling spalls, and packrat midden debris resting on the bedrock floor. Stratum C, the primary artifact-bearing unit, was an unconsolidated deposit of very loose, light orange-brown silty sand with localized occurrences of rodent burrowing, sandstone ceiling spalls, and minute specks of charcoal. Stratum C was essentially the occupation unit of the western bedrock shelf. Stratum D graded into the bedrock

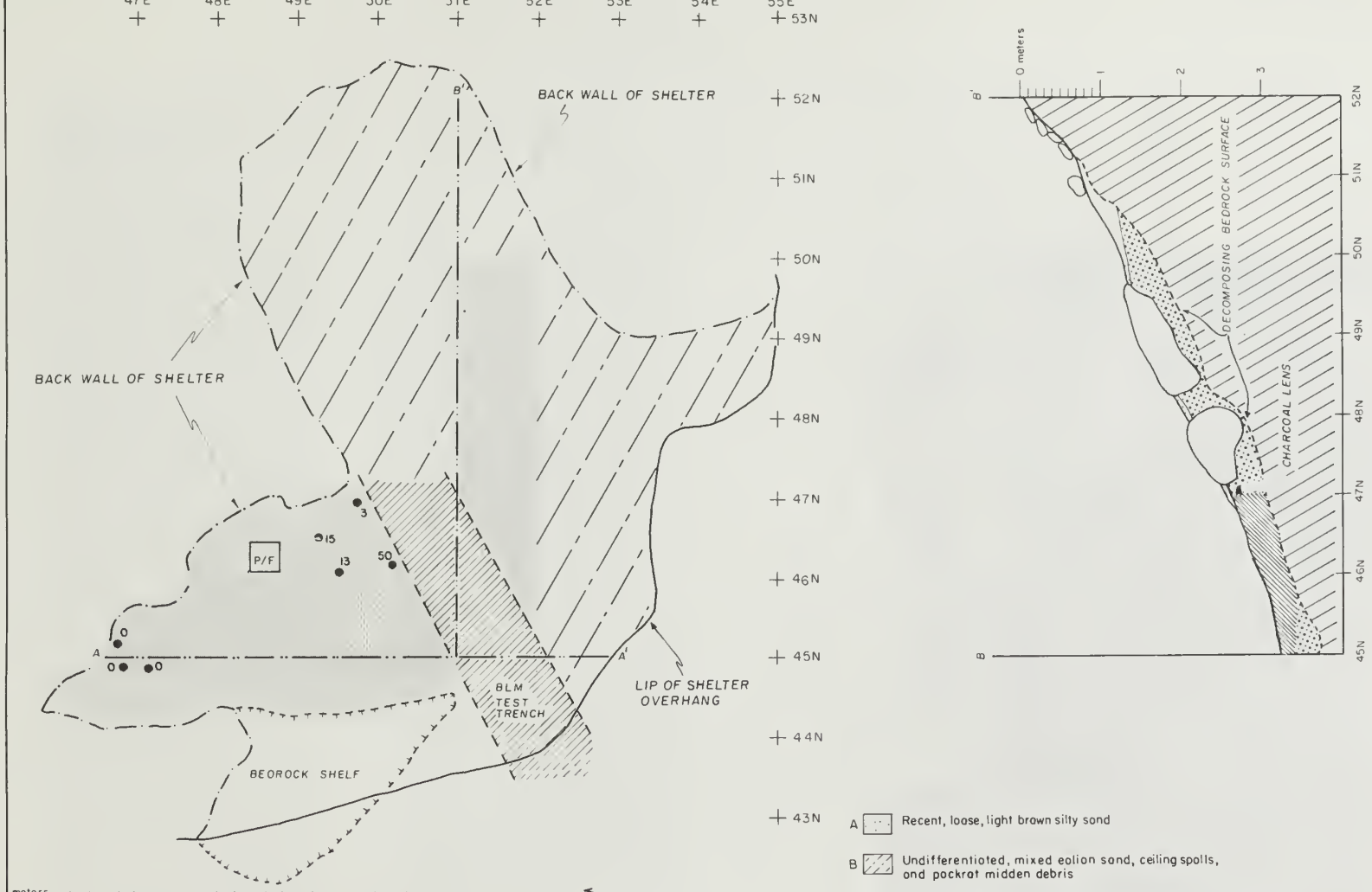


FIGURE 4.5. 42Ws1633 Plan & Profile

floor of the rockshelter and was composed of loose orange-brown sandy silt and decomposed bedrock sand. The floor was highly decomposed and pocked with rodent burrows.

Chronology and Cultural Affiliation

No radiocarbon dates are available for this site, since the charcoal pieces in the rockshelter deposits were too small and scattered to obtain a reliable sample. Although a relatively small quantity of ceramics was recovered (n=20), the majority include Shinarump Corrugated, with lesser numbers of Virgin Series and Shinarump plainwares and Southern Paiute Utility Ware (Blinman, Chapter V). Ceramic data generally indicate a Pueblo II period Virgin Anasazi occupation and a subsequent Southern Paiute occupation.

Additional support for a historic Southern Paiute occupation comes from two non-crimped .22 rifle cartridges which were found, indicating a pre-A.D. 1900 date (see Chapter VII). Second, a piece of woven cochineal-dyed wool trade cloth was also recovered. Cochineal dyes were prevalent from the 1860s to about 1875 (Dr. Ann Hedlund, Arizona State University: personal communication). These historic artifacts complement the ethnohistoric record of Southern Paiute occupation of the St. George Basin during the 1870s (Fowler and Fowler 1971), as well as the radiocarbon dates obtained for the other archaeological features in the Washington City-Green Spring project area associated with historic Southern Paiute use (Appendix C).

Subsistence Data

Two pollen samples and two flotation samples were collected for analysis, as were a number of dried vegetal remains (Hevly and Edwards, Appendix A). Of the two pollen samples, only one yielded sufficient pollen for a statistically reliable count and no charred plant parts were recovered from the flotation analysis. Economic plant species represented in the pollen spectra include Ephedra, Artemisia, Cheno-ams, Allium, and Poacaceae sp. These plants may have been available in the immediate vicinity; interestingly, no aquatic species are represented in the pollen spectra.

In the collection of dried vegetal material, of particular interest, is a mass of cut and pounded strips of Juniperus bark (Figure 4.16). Other plants include several bunches of uprooted Aristida purpurea (three-awn grass)and Stipa (needle grass), a bundle of Chrysothamnus (rabbitbrush) twigs, bark, and root stock, and a section of Phragmites which had been cut at an acute angle at one end. Phragmites could have been obtained from nearby Green Spring or the Virgin River. Aristida and Chrysothamnus could be gathered from dry rocky slopes in the general vicinity of the rockshelters. Juniperus and Stipa, however, grow at elevations from 3000 feet to 7000 feet and would have been obtained from the plateaus or mountain foothills surrounding the St. George Basin.

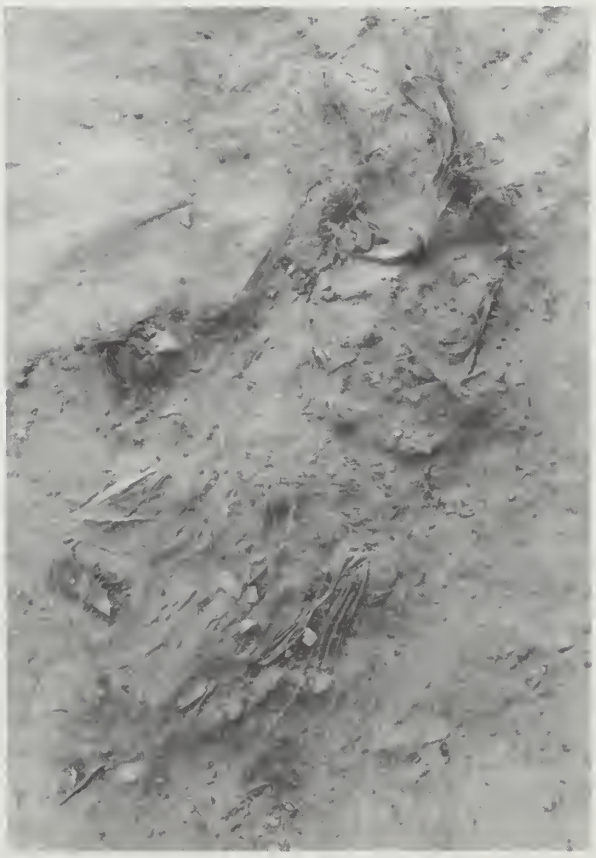


FIGURE 4.16. 42Wsl633: Massed, cut and pounded juniper bark and grasses on western shelf of rockshelter interior.

Lastly, 42Wsl633 yielded the largest and most varied assemblage of faunal bone specimens (Mead, Appendix B). These include Sylvilagus, Lepus, Artiodactyla sp., Bison/Bos, Taxidea taxa, Canis latrans, Canis sp., as well as numerous scraps of unidentifiable mammals and reptiles. of which 18% were burned, including bones of Sylvilagus, Lepus, Bison/Bos, and Artiodactyla. When the 42Wsl633 faunal bone assemblage is compared to that at 42Wsl629 (which also yielded substantial bone specimens), several differences are apparent. First, there is a lower incidence of burned bone at 42Wsl633, whereas at 42Wsl629, over half of the bone was burned. This difference may indicate less intensive animal food processing at 42Wsl633, and is consistent with the restricted range of lithic tools recovered from 42Wsl633, implying resource processing specialization (see Material Culture, below). Second, there is an overall higher proportion of rabbits and hares to a lower incidence of large game mammals at 42Wsl633, whereas the converse is true for 42Wsl629. Hence, there appears to be a selective emphasis on procuring and processing small game animals at 42Wsl633. Lastly, the presence of several Bison elements raises the question of Bison procurement, since

modern bison are not known to have ranged into southwestern Utah. Until such evidence is forthcoming, we assume that the bison elements may have been obtained through trade. This problem is explored at length in the conclusions of this report (see Chapter VIII).

Altogether, the pollen, macrofloral, and faunal bone evidence shows an emphasis on local plants and small mammals available in the immediate vicinity of Green Spring. The presence of large mammal remains and the juniper bark matting indicates procurement of these resources from higher-elevation localities some distance away from the site. Since most of the faunal bone was recovered from a single 50-cm unit in the BLM test trench, it is not possible to identify Virgin Anasazi or Southern Paiute resource emphases.

Material Culture

Material culture items recovered from 42Ws1633 include ceramics, lithics, and several historic items, of which some of the latter may have been associated with a human burial.

Twenty ceramic sherds were recovered from the rockshelter interior (see Blinman, Chapter V). The assemblage is dominated by Shinarump Gray Ware (n=14; 70%), with a lesser number of Tusayan Gray Ware: Virgin Series (n=5; 25%) and Southern Paiute Utility Ware (n=1; 5%). Jar body sherds are dominant (n=17; 89%) in the Virgin Anasazi collection, while the single Southern Paiute sherd was from a bowl. Vessel rim forms indicate a cooking/storage jar function. Given the context and low number of sherds, it is probable that a few storage jars were once used during with the Virgin Anasazi occupation; however, little can be said regarding Southern Paiute use of ceramic vessels.

A total of 33 lithic artifacts were recovered from 42Ws1633, of which 13 were tools or tool fragments (Table 4.4; see Chapter VI). The composition and characteristics of the lithic assemblage indicate limited butchering and processing of faunal remains, while the presence of several grinding slab fragments indicates plant resource processing activities.

Three historic artifacts were recovered from 42Ws1633: two spent .22 rifle cartridges and a piece of machine-woven, red-dyed wool cloth. The cartridges consist of one uncrimped Henry Short rifle cartridge, and one uncrimped Winchester Long rifle cartridge. As noted earlier, uncrimped rifle cartridges were made up to A.D. 1900. The cochineal-dyed wool cloth had been cut into a triangular shape from a parent cloth of diagonal 2/2 balanced twill weave. Dr. Ann Hedlund, who analyzed the textile has commented that cochineal was the predominant red dye used during the 1860s and up to about 1875. Moreover, "trade cloth such as this was frequently used in the Plains and Southwest to trim handicrafts--bound edges on bags and moccasins, inset along with beadwork on garments" (Dr. Ann Hedlund: personal communication). The use of red wool cloth to decorate Ute leather leggings is illustrated in the current report, A Nineteenth Century Ute Burial from Northeast Utah (Fike and Phillips 1984: Figure 51, p. 57). It is possible that this cloth is associated with the remains of a human burial, which is discussed hereinafter.

TABLE 4.4. 42Ws1633: Lithic Artifact Summary.

Artifact Type	Frequency
Projectile Point: Elko Series	0
Projectile Point: Numic types	0
Projectile Point: Other/Unknown	3*
Biface/Knife	1
Unifacial Scraper	0
Retouched Flake Tool	1
Utilized Flake	2
Graver/Perforator	0
Wedge	0
Denticulate	1
Abraded Cobble Tool	0
Hammerstone	1
Hammerstone Resharpening Flake	1
Grooved Abrader	0
Mano	0
Grinding Slab	3
Core	1
Debitage	19
TOTAL	33

* 1 reworked Gypsum point
1 Late Protohistoric point
1 point tip fragment

Human Burial

Fifteen elements of a human skeleton were found in scattered locations along the back wall of the western shelf of the rockshelter. The scattered distribution and incomplete inventory of the elements probably resulted from disturbance by rodents and other natural processes. The results of the skeletal analysis indicate an American Indian male who died at approximately 17 years of age. No pathologies or anomalies were evident in the bone specimens and the cause of death could not be ascertained. The majority of the bones were from the left side of the individual. If natural decay and erosion contributed to the loss of right-side elements, it is probable that the body was interred on its right side (Taylor, Appendix D).

The nature and context of the skeletal elements may indicate the remains of a southern Numic, perhaps Southern Paiute, crevice burial (cf. Fike and Phillips 1984; Nickens 1984; Smith 1974; Sweeney and Euler 1963). It is possible that the single piece of red wool cloth recovered from the rockshelter fill, dated to the historic period (ca. A.D. 1860s-1875), was associated with the burial. Additional support for this conclusion is reported in Nickens' (1984) ethnographic summary of Ute burial practices. Crevice burials seem to have been more common in pre-reservation times (e.g., prior to A.D. 1891), whereas the post-reservation era marked a change to cemetery interment.

Exchange

Limited exchange among the Pueblo II Virgin Anasazi occupants of 42Ws1633 is indicated by the dominanace of Shinarump Corrugated pottery in the ceramic assemblage, which is similar to that observed for 42Ws1631 and 42Ws1632 (see Blinman, Chapter V).

Trade items associated with the Southern Paiute group(s) who used the rockshelter include obsidian from the Mineral Mountains in Beaver County, Utah (Chapter VI), the red wool cloth piece (Chapter VII), and possibly bison bone elements (Mead, Appendix B). Collectively, these items indicate Southern Paiute relationships with the more northerly Numic groups, a proposition substantiated by the characteristics of the crevice burial recovered from this rockshelter. Post-contact Southern Paiute exchange with Anglo-Americans might be indicated by the two .22 rifle cartridges.

Logistical Organization

This rockshelter was used during the Virgin Anasazi Pueblo II period, and again by the Southern Paiute at a later time. Both the Virgin Anasazi and Southern Paiute appear to have used the rockshelter for limited or specialized subsistence activities as indicated by the relatively low number and low variety of material culture items. However, the presence of upland plant and animal remains indicates the exploitation of a relatively wide-ranging resource catchment area. Hence, it is probable that groups occupying a residential base at one of the other rockshelters (e.g., 42Ws1631 or 42Ws-1632) may have also used 42Ws1633 for a specialized resource processing locality. Lastly, the rockshelter was used for the interment of a historic Southern Paiute burial.

Site 42Ws1634

Introduction

Site 42Ws1634 is the westernmost and last of the rockshelters in the series that were investigated. The site is a relatively shallow alcove situated at a slightly higher elevation than the other five rockshelters and was not previously tested prior to excavation.

Description

The rockshelter is a low shallow concavity extending 6.2 m wide at its mouth, 2.1 m deep, and approximately 2.0 m high. The high angle of the overhang, however, allows only a 1.0 m deep interior area sheltered from the afternoon sun.

Investigation of 42Ws1634 commenced by excavating two contiguous 1-m by 1-m units as a 1-m by 2-m east-west trench through the center of the rockshelter fill. The trench was then subsequently expanded by excavating two additional 1-m by 1-m units into the interior of the alcove.

Stratigraphy

Site 42Ws1634 was the only rockshelter with undisturbed stratigraphy. Three strata were defined (Figures 4.17 and 4.18). Stratum A was a layer of recent loose eolian sand with several sandstone spalls derived from ceiling collapse. A few artifacts, seeds, and charcoal pieces were recovered from Stratum A. Stratum B was nearly identical to Stratum A, except that the sand was more compacted. Stratum C consisted of decomposed sandstone bedrock, grading to hard sandstone bedrock with depth. The decomposed sandstone characteristically changes from a chalky white to ashy gray color as a result of rapid oxidation upon exposure to air, a phenomenon noted at all of the rockshelters.

Chronology and Cultural Affiliation

One charcoal sample from Stratum A was submitted for radiocarbon dating. The sample dated to 150±50 B.P. (A.D. 1800±50) (Appendix C). Although no diagnostic artifacts were recovered, the radiocarbon date is most likely associated with a historic period occupation.

Subsistence Data

One pollen sample and several macrofloral specimens recovered from the screened fill were analyzed. Economic species represented in the pollen record include Typha, Ephedra, Opuntia, Artemisia, Brassicaceae sp., and Cheno-ams. The seeds recovered from the screened fill were identified as Prosopis juliflora, which most likely were collected from mesquite trees growing near Green Spring. Faunal bone from 42Ws1634 includes specimens of Lepus, Sylvilagus, and Thomomys. None were burned, so it is uncertain if these bones were deposited by natural or cultural processes. In summary, the subsistence data indicates a probable late summer-early fall occupation of the rockshelter, during which the occupants exploited resources available in the immediate vicinity of Green Spring.

Material Culture

No ceramics were recovered from 42Ws1634. The lithic inventory from this site includes 1 biface, 1 hammerstone, and 4 pieces of debitage (see Chapter VI).

Exchange

As indicated by the material culture assemblage, no evidence of exchange was found.

Logistical Organization

Subsistence data and material culture assemblage from this site indicate use of the rockshelter as a locality for plant resource processing, utilizing resources available in the immediate vicinity. Although no diagnostic artifacts were found, the absence of Euro-American artifacts and the A.D. 1800±50 radiocarbon date suggests a historic Southern Paiute occupation.

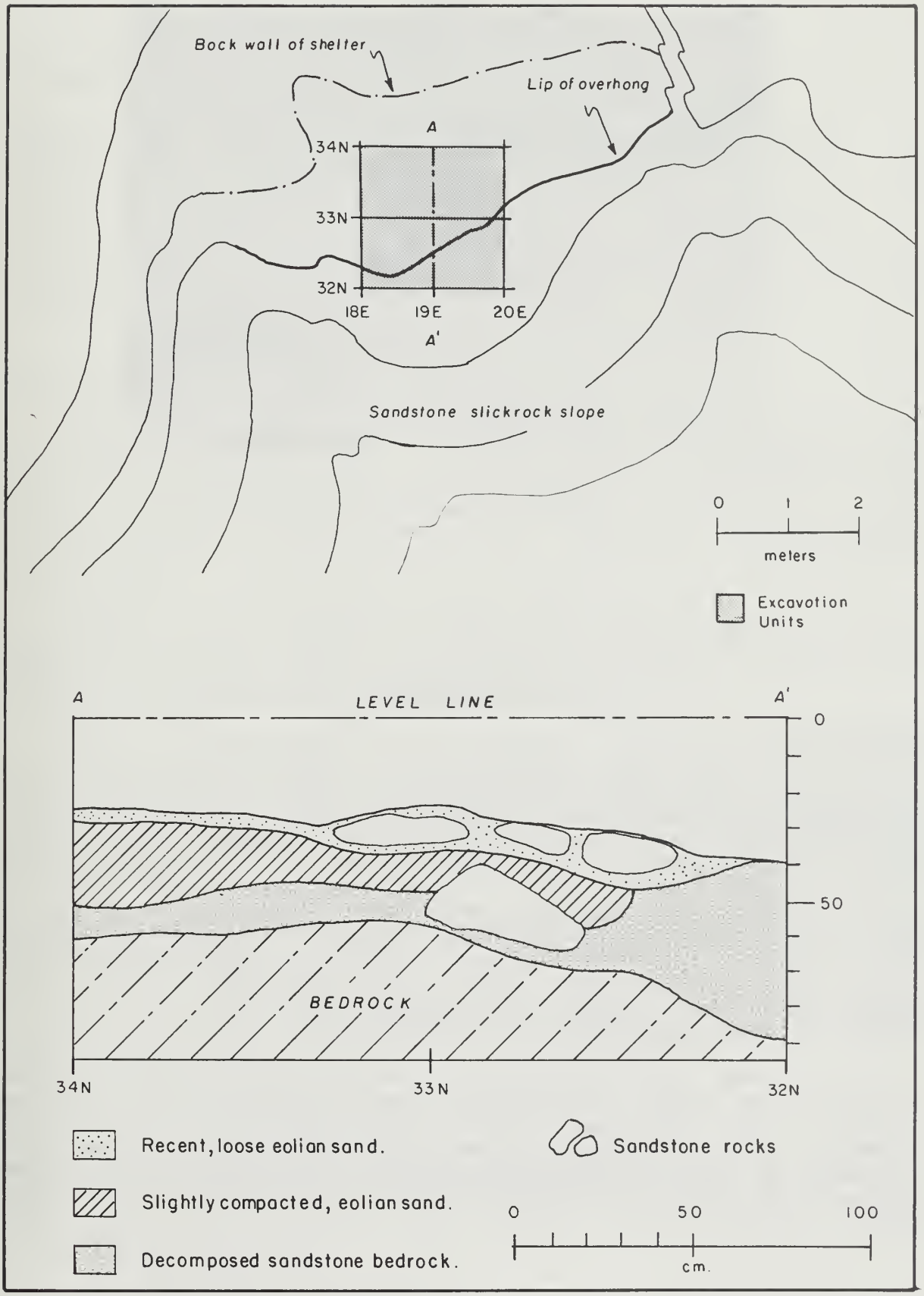


FIGURE 4.17. 42Ws1634: Plan and profile map.

FIGURE 4.18. 42Ws1634: Excavation Units 34N 18E and 34N 19E, showing interior fill of shelter.

Site 42Ws1828

Introduction

The site designation 42Ws1828 is applied to seven hearths situated in various localities across the ridge lower slope below the rockshelters. Three of these features were originally defined during the BLM testing program. One was designated Feature 3 at Site 42Ws1629, and two were designated Features 3 and 4 at Site 42Ws1633 (Dalley 1984). During the excavation phase four additional hearths were found and investigated. Because all of the hearths were spatially and stratigraphically separate from the rockshelters and lacked diagnostic artifacts, it was not possible to determine if they were functionally associated with the use of the rockshelters. Hence, all of these exterior hearths were collectively subsumed under a separate site number for ease of discussion. (see Table 4.5).

The hearths can be classed into two functionally different types. Firehearths are simple shallow basins scooped out of the shallow soil and floored on the underlying bedrock. These generally contained a fill of charcoal, ash, charcoal-stained soil, and a few random, smudged rocks. Roasting pits, on the other hand, were generally larger, and contained abundant charcoal, ash, charcoal-stained soil, and numerous oxidized and smudged rocks.

TABLE 4.5. 42Ws1828, Feature Designations.

New Feature Designation	Original Feature Designation	Feature Type
42Ws1828 - Fea. 1	Grid Unit 46N 120E, Fea. 1	Firehearth
42Ws1828 - Fea. 2	Grid Unit 46N 120E, Fea. 3	Firehearth
42Ws1828 - Fea. 3	Grid Unit 40N 126E, Fea. 2	Roasting Pit
42Ws1828 - Fea. 4	Grid Unit 10N 140E, Fea. 4	Firehearth
42Ws1828 - Fea. 5	42Ws1629 - BLM Feature 3	Firehearth/ Charcoal Dump
42Ws1828 - Fea. 6	42Ws1633 - BLM Feature 3	Roasting Pit
42Ws1828 - Fea. 7	42Ws1633 - BLM Feature 4	Firehearth

Features 1 and 2

Features 1 and 2 are situated adjacent to each other on the ridge slope approximately 31 meters below (south of) 42Ws1631. They were initially identified as a single large, oval-shaped deposit of powdered charcoal, charcoal flecks, and smudged sandstone rocks at a depth 4 to 5 cm below the modern ground surface (Figure 4.19). Subsequent excavation revealed two oval basins that had been scooped out of the soil down to bedrock (Figures 4.20 and 4.21).

Feature 1 is an irregular oval basin 1.03 m east-west by 0.58 m north-south, and 10 cm deep. The fill was composed of very dark gray silt with abundant small charcoal flecks, some smudged sandstone rocks, and no artifacts. This was overlain by recent grayish brown eolian sand.

Feature 2 is a rounded basin, measuring 1.10 m east-west by 0.95 m north-south, and 13 cm deep. It appears to be earlier than Feature 1, since its contents were overlain by a deposit of orange-brown silt, which was absent in Feature 1. The fill of Feature 2 was composed of dark gray silt with abundant charcoal flecks and pieces, several smudged sandstone rocks, and no artifacts.

An area approximately 6 m by 6 m encompassing the exterior perimeter of Features 1 and 2 was stripped down and screened. Only a few lithic debitage flakes were found (see Chapter VI).

Two charcoal samples, one each from Features 1 and 2 were submitted for radiocarbon assay. Both samples yielded "Modern" dates (ca. A.D. 1850-1950) (Appendix C).

Feature 3

Feature 3 is located approximately 9 meters directly southeast of Features 1 and 2. It is situated on a relatively level sandy surface. Unlike Features 1 and 2, Feature 3 was more carefully constructed, and appears to have functioned more as a roasting pit rather than as a simple firehearth (Figures 4.22, 4.23, and 4.24).

FIGURE 4.19. 42Ws1828: Feature 1, firehearth prior to excavation, view to the west.

FIGURE 4.20. 42Ws1828: Features 1 (top) and 2 (below) after excavation. View is to the north.

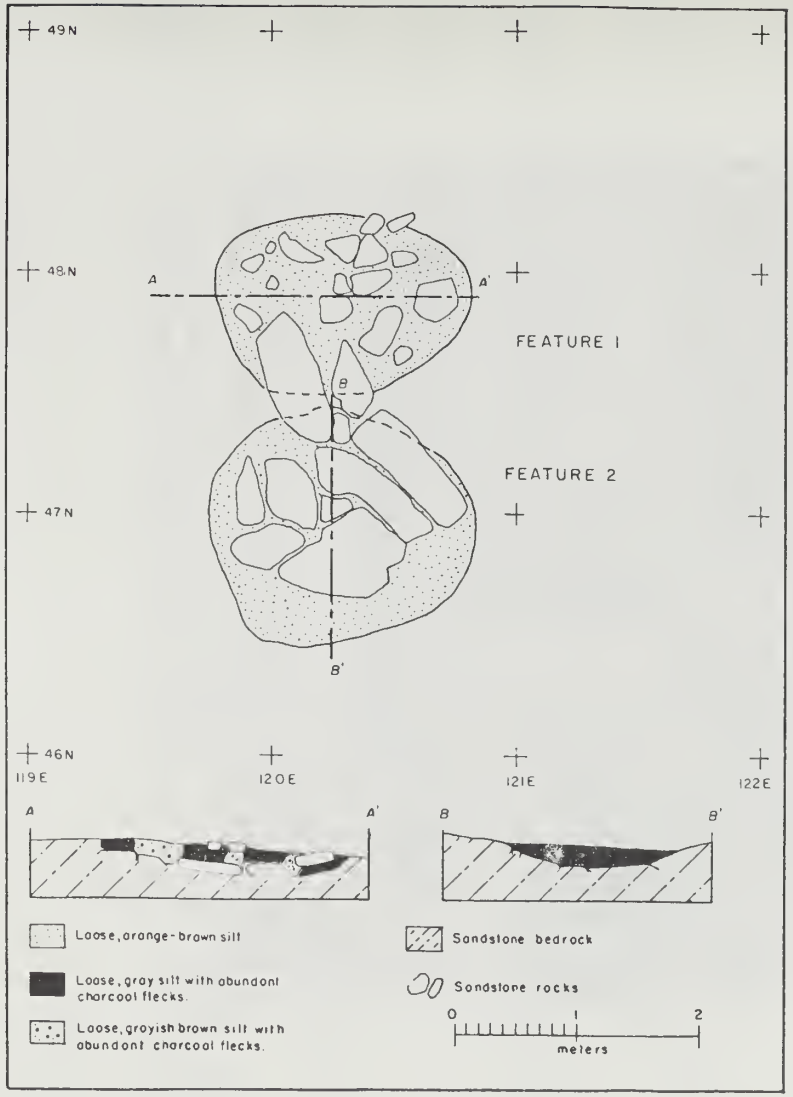


FIGURE 4.21. 42Ws1828: Features 1 and 2, plan and profile maps.

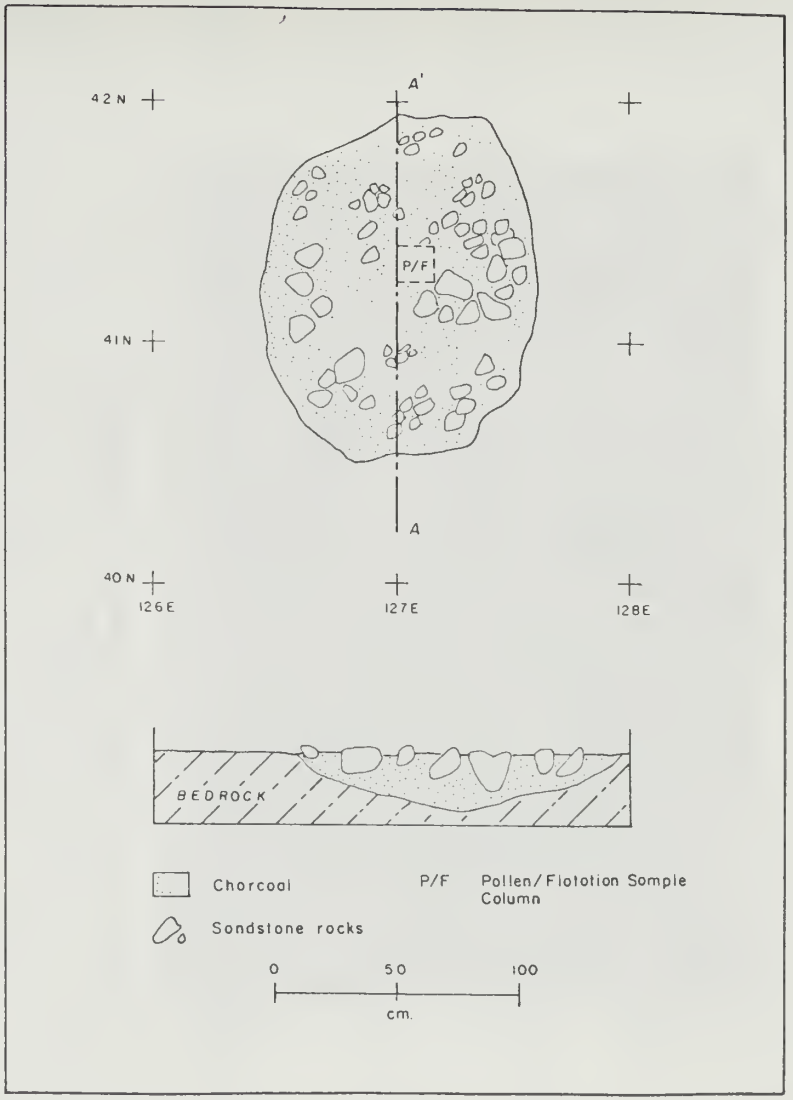


FIGURE 4.22. 42Ws1828: Feature 3 plan and profile map.

FIGURE 4.23. 42Ws1828: Feature 3 (roasting pit) prior to excavation. View is to the west.

FIGURE 4.24. 42Ws1828: Feature 3, showing cross-section of fill interior. View is to the west.

Feature 3 was constructed by scooping out a large oval basin, measuring 1.38 m north-south by 1.14 m east-west, and 0.24 m deep. The pit had been originally excavated down to the bedrock substrate. The fill of the pit consisted of powdered charcoal and abundant charcoal pieces and chunks. Smudged and burned sandstone rocks occurred in the upper 15 cm of fill. No artifacts were found within the pit. An area 2 m east-west by 4 m north-south around Feature 3 was stripped down and screened; however, only a few lithic debitage flakes and ceramic sherds were recovered.

A charcoal sample from the lower center of the fill yielded a date of 140±60 B.P. (A.D. 1810±60 B.P.), which is within the historic period of occupation of the St. George Basin (Appendix C).

Pollen and flotation samples collected from Feature 3 yielded no significant data concerning economic plant species, and no faunal bone was recovered.

Feature 4

Feature 4 is located at the edge of a main collector drainage for the numerous small runnels dissecting the ridge slope. It is situated on a small sandy flat on the north side of the arroyo (Figures 4.25 and 4.26).

Feature 4 is a small ephemeral firehearth that lacks evidence of formal preparation. It is a shallow, oval basin scooped out of the sand and is floored on the underlying bedrock substrate. Feature 4 measures 0.70 m north-south by 0.90 east-west, and is 5 cm deep. The fill consisted of dark gray-stained sandy silt intermixed with powdered charcoal and charcoal pieces. An area 2 m by 2 m around Feature 4 was stripped down and screened. A single lithic debitage flake and a few grayware sherds were the only artifacts recovered, all of which were in the fill.

A charcoal sample collected from the lower fill of Feature 4 yielded a date of 80±60 B.P. (A.D. 1870±60) (Appendix C). This is consistent with the other A.D. 1800s dates obtained for other features in the project area and accords well with the historic occupation of the St. George Basin.

Pollen samples collected from Feature 4 yielded no appreciable economic pollen counts. A flotation sample, however, did yield a burned bulb fragment, identified as Calochortus (Mariposa or sego lily) (Hevly and Edwards, Appendix A).

Feature 5

Feature 5 (originally 42Ws1629 - BLM Feature 3) is located 26 meters below and southeast of 42Ws1629. This feature was originally discovered by excavation of the BLM test trench (Feature 2) (Dalley 1984).

Feature 5 is a lens of charcoal and ash resting on a thin veeneer of decomposed bedrock sand and overlain by recent eolian sand (Figure 4.27). There was no evidence of primary burning. Six 1-m by 1-m units were stripped down around Feature 5, but no additional features were found.

FIGURE 4.25. 42Ws1828: Feature 4, firehearth. View is to the north.

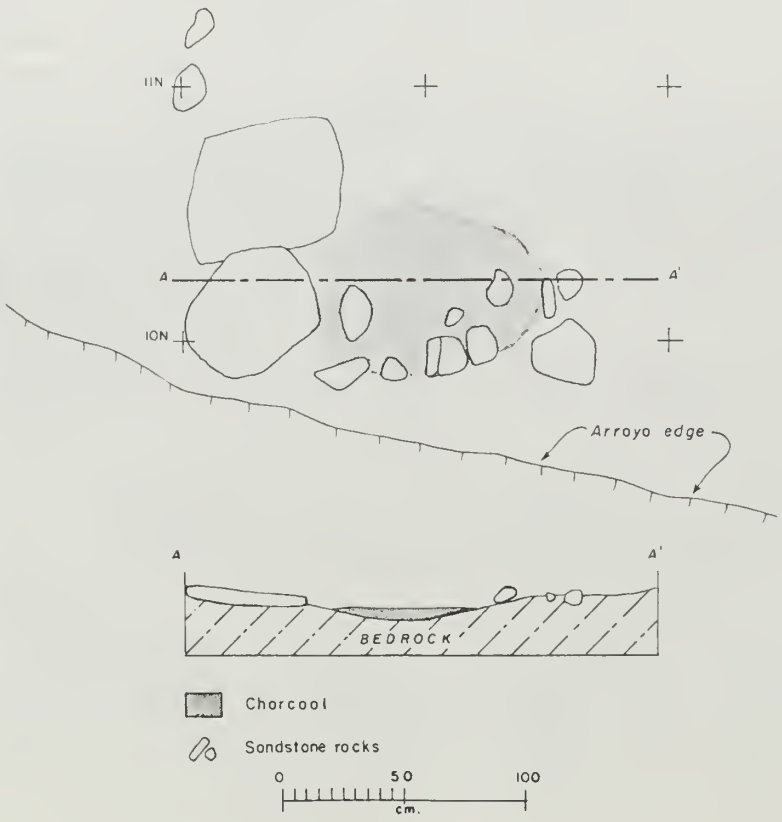


FIGURE 4.26. 42Ws1828: Feature 4 plan and profile map.

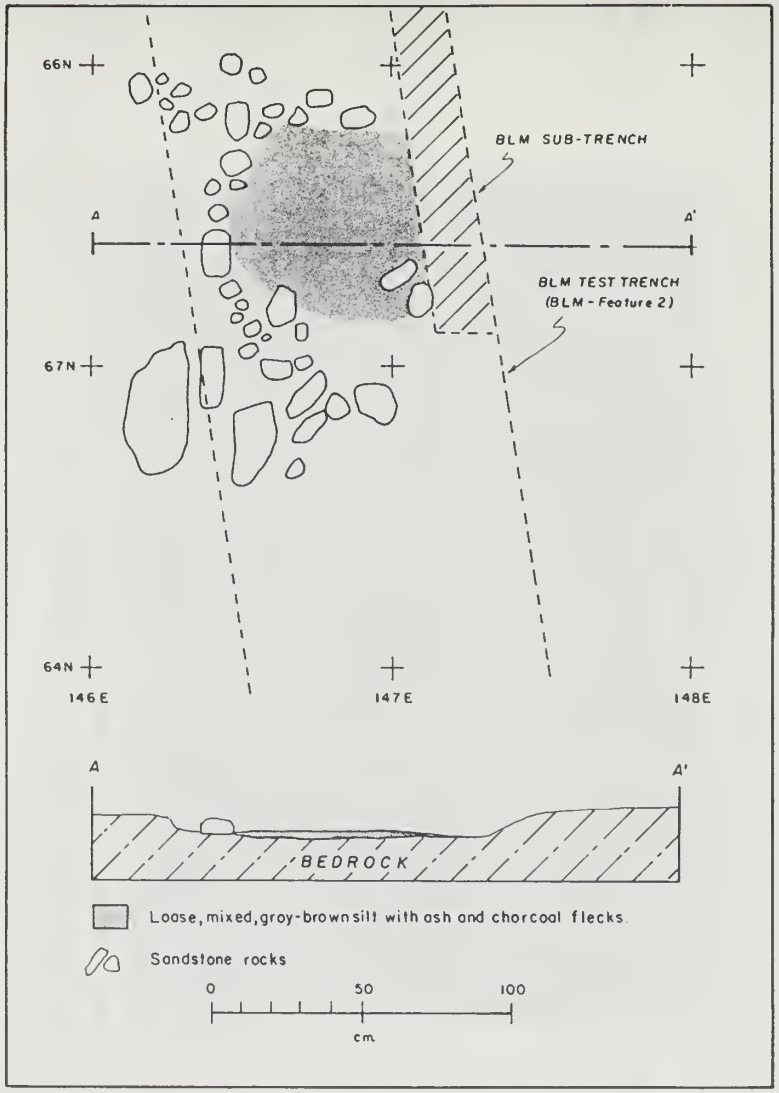


FIGURE 4.27. Feature 5 (ash/charcoal dump or hearth), plan and profile map.

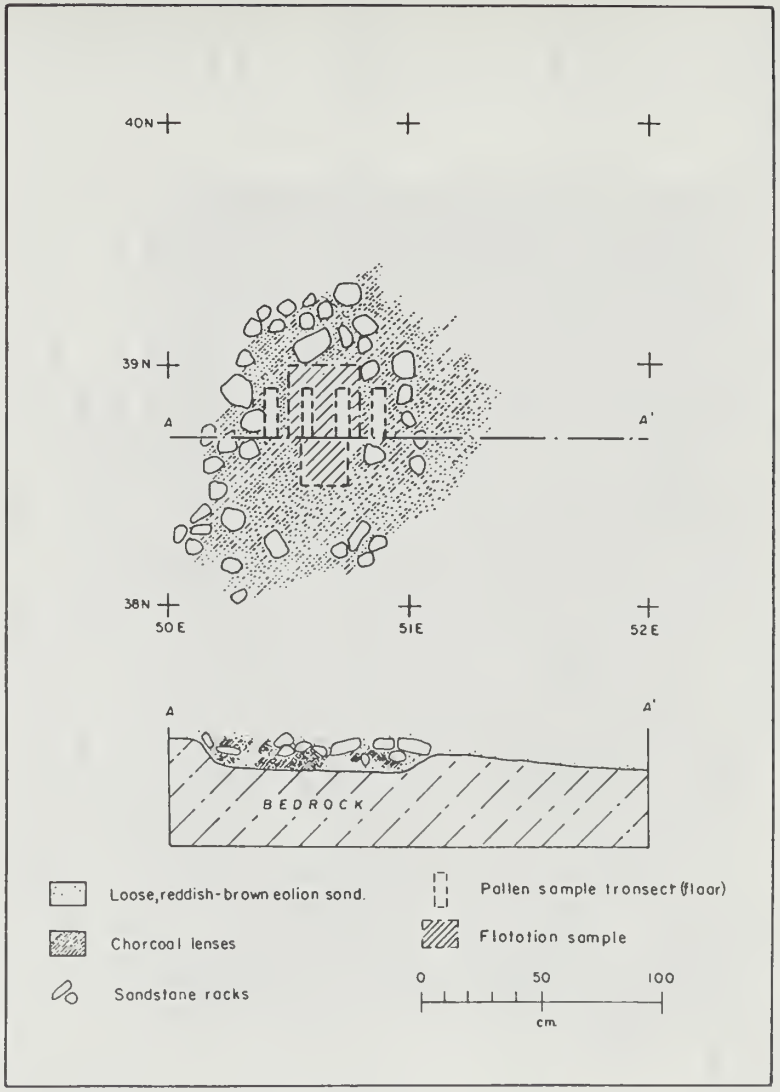


FIGURE 4.28. 42Ws1828: Feature 6 (roasting pit), plan and profile map.

One pollen and one flotation sample were analyzed. The pollen sample had too little pollen for a statistically reliable count and no burned plant parts were recovered from the flotation sample (Hevly and Edwards, Appendix A). No faunal bone was recovered.

In summary, Feature 5 most likely represents a secondary deposit of charcoal and ash, discarded from a firehearth located elsewhere in the near vicinity. The age and affiliation of this feature are not determinable from the limited data, although it is presumed to be a Southern Paiute feature due to its ephemeral characteristics.

Feature 6

Feature 6 is located on a level ground surface directly below 42Ws1633. It was first discovered in the BLM test trench (42Ws1633 - BLM Feature 2) excavated in front of and directly below the rockshelter.

Feature 6 is a rock-filled roasting pit originally 8 cm below the modern ground surface. The firepit is an unprepared oval shallow basin scooped out of the surface soil. The pit measures approximately 1.35 m northeast-southwest by 0.95 m northwest-southeast, and averages 10 cm deep. The interior contained a mixed fill consisting of abundant smudged rocks, powdered charcoal and charcoal pieces, and lenses of brown sand (Figures 4.28, 4.29, and 4.30). No artifacts were recovered from the pit fill. An area 2 m by 2 m encompassing Feature 6 was stripped and screened; no artifacts were found.

A radiocarbon sample collected from the fill of Feature 6 yielded a "Modern" date (ca. A.D. 1850-1950), indicating usage either during the historic period or in more recent time.

Pollen samples from Feature 6 revealed insufficient pollen to obtain a reliable count, and no plant remains (other than charcoal) were recovered from the flotation samples.

Feature 7

Feature 7 is located 6 meters southeast of Feature 6. It was originally designated 42Ws1633 - BLM Feature 3, and was discovered and excavated during the BLM site testing phase. The following description is taken from the testing phase field notes (Dalley 1984).

Feature 7 is an oval, basin-shaped firepit constructed by scooping out the surface soil down to the sandstone bedrock substrate. The basin measures 0.70 m north-south by 0.60 m east-west, and is 7 cm deep. The fill consisted of sand and charcoal.

A charcoal sample from the fill yielded a "Modern" date (ca. A.D. 1850-1950), indicating use of the firehearth at some time during the historic period or in more recent time.

FIGURE 4.29. 42Ws1828: Feature 6, roasting pit prior to excavation, viewed to the west.

FIGURE 4.30. 42Ws1828: Feature 6 after excavation with interior rocks shown at right of photo.

Pollen samples from the fill yielded an unusually high frequency of Ambrosia-type Compositae (ragweed) pollen, but this is not a documented economic species. No plant parts were recovered from the flotation sample (Hevly and Edwards, Appendix A).

Summary and Discussion

In summary, of the seven hearths on the ridge slope, six appear to be the remains of short-term camps associated with transient activities (Features 1, 2, 3, 4, 6, and 7), while the seventh (Feature 5) lacked well-defined morphological attributes to verify its function. Radiocarbon dates for the six datable features indicate construction and use of the hearth features from A.D. 1810±60 to recent times. Although no diagnostic artifacts were recovered from these features, their physical attributes and the absence of recent or modern Anglo-American artifacts suggest Southern Paiute usage. Hearths of similar construction and fill content have been reported at Southern Paiute camps in the Beaver Dam Mountains southwest of the St. George Basin (Moffit et al. 1978). The function of small hearths and roasting pits such as these has been described by Dr. Edward Palmer, who conducted ethnographic studies among the Southern Paiute during 1866-1877 (Heizer 1954:56). To wit:

Pah Ute Indians - Cooking by Heated Stones

> A quantity of rocks are piled up; a hot fire is made over them and when hot the ashes are brushed off, water is profusely sprinkled over these; then greens or native plants, of which these Indians eat many, are laid over the steaming hot rocks which soon reduce the fresh green mass to an edible compound greatly relished by these Indians.
>
> Young grass and clover are often thus cooked to eat.
>
> Piles of stones that have been used for this heating process are often met with in Utah and Nevada.

Pah Ute Indians - Bake Stones

> These Indians have a curious mode of baking small animals and birds in use previous to and after the settlement of the country by whites. It consisted in digging a round hole and lining it with cobble stones which are closely placed side by side and a little in the ground; wood or brush laid over and burned until the rocks were sufficiently heated; the ashes were then cleaned out and what ever was to be baked, animal or fowl, were (sic) placed in these small heated pits. Weeds and grass were covered over all and in a short time it was cooked sufficiently. Sprinkling the hot rocks with water aids the cooking very much.
>
> Game of any kind cooked this way was said to be very good.

> These, now unused pits or ovens are often met with in Utah. The most noted place to find these bake ovens was five miles West of North from the city of Beaver, Utah on a bench or narrow piece of level land covered with sage brush and contiguous to a piece of low meadow land many was found. Rabbits the favourite food of the Pah Ute Indians delight to live in sage brush and when near moist grassey (sic) meadows there they congregate in large numbers, as was the case with the above mentioned locality and this accounts for so many bake ovens being found there. They are two feet deep and two feet across circumference 6 feet, side and bottoms lined with cobble stones. These ovens are not so much used now.

As stated earlier, a functional association between exterior hearth use and rockshelter occupation cannot be verified, due to the lack of correspondence between the material culture assemblages from the two respective feature types. However, the radiocarbon dates from both the rockshelters and the firehearths collectively would fit within the time span A.D. 1800-1900, which is compatible with the historic period of occupation of the St. George Basin. Thus, these firehearths may represent another dimension of Southern Paiute logistical organization, whereby the Green Spring locality was used for transitory outdoor camping. The roasting pits, on the other hand, represent a greater investment of time and labor in resource procurement and processing activities. The recovery of Calochortus (mariposa or sego lily) bulbs from Feature 4 indicates an early spring occupation, although data are not available to evaluate the seasonality of use of the remaining six hearth features.

CHAPTER V

ANALYSIS OF CERAMICS FROM THE PROJECT SITES

by

Eric Blinman

Introduction

Nearly 1300 potsherds were recovered from six of the seven sites investigated in the vicinity of Washington City, Utah. These ceramic materials have the potential to provide information on the cultural affiliation of site occupations, dating of occupations, and site function. This potential is compromised to a degree by relatively small samples from most proveniences and by the mixing of cultural materials during the long span of the site occupations. However, the collections do provide enough information to approach these questions on both descriptive and comparative levels.

Ceramic-bearing occupations in the southwestern Utah area include those attributed to the Virgin or Western Anasazi (Colton 1952) and those attributed to the Southern Paiute (Baldwin 1950). In addition, a variety of pottery could occur as trade items or indicate incursions of people from adjacent areas of the greater Southwest. These include the Fremont to the north (Madsen 1977), the Hakataya to the south and southwest (Colton 1958; Dobyns and Euler 1958; Euler 1982), and the Kayenta Anasazi to the southeast (Colton 1955). Ceramics associated with these cultural units are distinguishable to varying degrees and have been identified in archaeological collections from the southwestern Utah, northwestern Arizona, and southern Nevada areas (Fowler et al. 1973:15-19; Moffitt et al. 1978:105-107; Marshall 1979; Schwartz et al. 1980:115-139; Schwartz et al. 1981:77-104; Dalley and McFadden 1985:142-155; Wilson 1985). Archaeological ceramics from the region have also been studied by Dr. Richard Thompson of Southern Utah State College and his students, but reports of their work were not available to the author during this analysis.

Temporal change within the various ceramic traditions in the region is clearly evident but is not as well calibrated by tree-ring dating as in other areas of the Southwest. Grayware chronological information is embodied in the presence or absence of exterior corrugation, and broad whiteware style dates are generally derived by comparison with Kayenta Anasazi styles and their associated time periods (cf. Schwartz et al. 1981:100-104; Wilson 1985). These approaches provide reasonable criteria for assigning relative dates for occupations within restricted geographic areas, but they do not provide support for precise absolute date estimates.

Although most archaeological studies of ceramics focus on typological classification and dating, the presence of potsherds in archaeological sites is a direct consequence of the use and breakage of vessels in functional contexts. Characteristics of vessel shape can be equated with particular functions on the basis of both theoretical considerations (Ericson et al.

1972; Smith 1985) and empirical studies (Blinman 1985; Hally 1985). In the absence of reconstructible vessels, vessel form classes can be inferred from the variety of shapes represented in the sherd collection. The possible functions represented by the form classes can then be used to infer broader aspects of the activities carried out at the site (e.g., Shapiro 1984). Inferred activity sets or emphases can then be compared between sites or site types and across time.

Analysis Procedures

Analysis procedures were designed to record data appropriate for paste characterization, assessment of temporal affiliation, and inference of vessel characteristics. Paste characterization of all sherds was accomplished through binocular microscope examination and classification of sherds into paste/temper categories on the basis of observed characteristics. In addition, samples of some sherds were subjected to refiring analysis as a coarse means of evaluating paste composition at the elemental level. As part of the assessment of temporal affiliation, styles of surface manipulation and design execution were recorded in terms of temporally sensitive classes. No reconstructible vessels were recovered in the collections, and vessel form classes were inferred on the basis of sherd morphology.

Binocular Microscope Examination

Freshly broken sections of all sherds were examined under a binocular microscope at a magnification of 20X. Nonplastic (temper) and plastic portions of the paste were observed and were used to group sherds into categories. Nonplastics were differentiated in terms of particle size, shape, transparency, color, abundance, and the diversity of particle characteristics within a given sherd. The plastic or clay matrix portion of each sherd was differentiated in terms of fineness (grain), homogeneity, and strength. Published descriptions of archaeological paste classes (Colton 1952, 1955; Baldwin 1950; Marshall 1979; Warren 1980; Wilson 1985) were used as guides for identifying significant paste features and for grouping observed paste classes into established pottery "traditions" or wares.

Refiring Analysis

The color of fired ceramics is imparted by the interaction of elemental composition of the paste and the chemical atmosphere attained during the final stages of firing. Considerable variability in firing atmosphere is associated with open firings and precludes meaningful comparisons of color between individual archaeological sherds. However, refiring (or controlled oxidation) of sherd samples in a consistent atmosphere can standardize the oxidation states of included elements and compounds. Color can then be used as a proxy measure of elemental composition, allowing valid comparisons between individual sherds (Shepard 1965:105-106; Bishop et al. 1982:277, 285). Refiring thus provides a rapid inexpensive means of comparing the compositions of archaeological ceramics, but there are some limitations. Different colors after refiring do imply different paste compositions, but identical paste colors do not necessarily imply identical compositions or

sources. Also, the success of standardization is dependent in part on the degree of vitrification achieved in the initial firing. Strong vitrification will isolate paste compounds from oxygen during refiring, usually resulting in dark brown colors and invalidating comparisons. Finally, measurement of color (by comparison with standard Munsell Soil Color references) is an estimation technique and is imprecise beyond a certain point.

Refiring samples in this analysis was standardized by firing in an electric resistance kiln with unrestricted access to oxygen. Kiln temperature was raised to 950 degrees C and immediately allowed to cool. Colors were recorded in Munsell Color notation in indirect sunlight. All paste colors were recorded for freshly broken surfaces (where the sample had been detached from the original sherd) to avoid the contamination associated with soil staining of sherd surfaces. Colors of slips could not be recorded on fresh surfaces, and the recorded colors are undoubtedly redder in hue and lower in chroma and value than they would have been under pristine circumstances. Slight vitrification was present in many sherds causing a gradation in color across the sherd section. In these cases, color was estimated for the portion of the sherd midway between the core and sherd surface. Most cases of extreme vitrification had been eliminated during sampling, but a single case was noted after refiring, and the color observation was discounted during data manipulation.

Stylistic Classes

Styles of surface manipulation and painted decoration are important to typological classification and to dating inferences. Surface treatment of gray wares can be plain, filleted, clapboarded, or corrugated. Plain surfaces are those in which coil junctures have been totally obliterated as a step in vessel manufacture. Filleted surfaces retain evidence of coil junctures, but the junctures have not been emphasized. Clapboarded junctures are emphasized, usually by lapping each coil over the preceding coil. Corrugated surfaces are filleted or clapboarded but the junctures are distorted by patterned indentations. Although the sequence from plain to corrugated is roughly chronological, there are some caveats to direct interpretation. Basketmaker III vessels are exclusively plain in surface treatment, but plain sherds can also be derived from basal portions of all later grayware vessels as well. The manipulation styles of filleting and clapboarding occur on the necks of Pueblo I grayware vessels, but portions of some Pueblo II and later grayware vessels can exhibit the characteristics of either filleting or clapboarding as variations on an otherwise corrugated surface. Sherds from these vessels can thus appear "filleted" or "clapboarded" without implying a Pueblo I affiliation. Usually these sherds can be distinguished from true Pueblo I sherds on the basis of thin coils and by the presence of manipulation below the shoulder of the vessel. Thus, surface manipulation must be interpreted in the contexts of both typological classification and characteristics of entire sherd collections rather than on an individual basis.

Following Wilson (1985) and others, stylistic terminology for painted decoration on whiteware sherds is derived from the classes that have been established for Kayenta Anasazi ceramic types (Colton 1955). These include Lino, Kana'a, Black Mesa, Sosi, Dogoszhi, and Flagstaff styles. Only Black

Mesa, Sosi, and Dogozshi styles could be recognized within the sherd collections, but many other painted sherds were too small to be confidently assigned to a specific design style. Most were clearly not derived from Lino, Kana'a, or Dogoszhi style vessels due to the presence of coarse line widths, and these sherds are classified as "post-Kana'a." Remaining painted white ware sherds are classified as indeterminate in style.

Vessel Form

Inference of vessel form from sherd morphology is hampered by extremely variable resolution. Important characteristics in determining functional classes of reconstructible vessels include orifice diameter, relationship between orifice and body diameter, presence or absence of a neck, presence of handles for maneuvering the vessel, and presence of attachments or holes for securing a cover over the orifice (Blinman 1985). Direct inference of use-wear from vessels depends upon the confident perception of patterns of sooting or abrasion by comparing different portions of the same vessel. These characteristics are either not inferable from individual sherds or can only be confidently inferred from a small number of the sherds produced by the breakage of an individual vessel. For this reason, individual sherds can have highly variable information content in terms of inferring the vessel form from which they were derived. Another aspect is that inferences are much more confident if the universe of potential parent vessel forms is well known. In the absence of extensive collections and reconstructible vessels, the range of potential parent vessels is poorly known for these collections, and vessel form classes must be generalized. The major generalized classes used in this analysis are bowl, cooking/storage jar, and olla. Bowls have little if any orifice constriction, cooking/storage jars have necks and moderately constricted orifices, and ollas have necks and extremely restricted orifices. Other vessel forms are well documented in Southwestern ceramic collections (e.g., ladles, seed jars, gourd jars), and the criteria for their recognition are adapted from Blinman et al. (1984).

Sherds were classified as deriving from bowls if there was evidence of interior decoration (including polish or smoothing) or if the rim was present and sherd curvature indicated that the rim diameter was equal to or nearly equal to the greatest diameter of the vessel body. Cooking/storage jar sherds include rim or neck sherds which exhibit both an absolutely large diameter orifice and an orifice that is less than the greatest vessel diameter. Sherds classified as ollas have a rim or neck indicative of an absolutely narrow orifice that is much smaller than the greatest body diameter. Body sherds from neck portions of vessels lacking sufficient curvature to estimate orifice size are assigned to a "cooking/storage jar or olla" category. Body sherds without evidence of a neck and with no indication of interior smoothing are classified as "jar body sherds" and could have been derived from cooking/storage jars, ollas, seed jars, or any other enclosed form. Some body sherds exhibit an ambiguous contrast between interior and exterior surfaces, and these are classified as "bowl or jar body sherds."

Quantification

The analysis procedure subdivides the sherds from an archaeological provenience into groups or "lots" within which all sherds share values for all observed variables (temper/paste class, firing atmosphere, exterior surface manipulation, vessel form, etc.). The sherds within a lot are counted (fresh breaks as a result of excavation or subsequent handling are discounted), and the aggregate is weighed. Sherd counts and percentages based on sherd counts are used for most comparisons, and weights are presented only for the project summary.

Paste Classes and Ceramic Traditions

Ceramic traditions are used in this discussion to describe sherds exhibiting consistent and easily distinguished combinations of raw materials and manufacturing techniques. Most ceramic traditions recognized in the Southwest are equated with cultural traditions (e.g., Hohokam, Mesa Verde Anasazi, Patayan), but differences in resource selection may create strong visual contrasts in ceramic materials without necessarily requiring contrasts in any other aspect of prehistoric culture. This is evident in the multiplicity of wares defined for the Virgin Branch or Western Anasazi region. Differences between Shinarump, Moapa, Virgin, Walhalla, and Kayenta wares all appear to be due to differences in resource use with some differences in manufacturing technique that are correlated with (and may be adaptations to) a given resource. With this background, six ceramic traditions have been recognized within the collections from the Washington City rockshelters, and these appear to represent three and perhaps four cultural or regional traditions.

Southern Paiute Ceramic Tradition

The plurality of sherds by count (majority by weight) recovered in the rockshelter collections can be attributed to Southern Paiute occupation of the area (Table 5.1). They conform in general to descriptions of Southern Paiute ceramics presented by Baldwin (1950). Sherd pastes are coarse and crumbly. Nonplastics are very heterogeneous and appear to fall into two co-occurring classes. The first class consists of abundant very fine (less than 0.20 mm diameter) rounded to subangular particles that are generally clear but also include significant amounts of white and some dark minerals. Many of these particles appear to be frosted, suggesting that they originate from aeolian or alluvial deposits. The second class of nonplastics consists of sparse large (0.25 to 1.50 mm diameter) angular to subangular particles. In most sherds, some or all of this class of nonplastics are white and very fine grained as if derived from a crushed quartzite or other aphanitic rock. In a minority of sherds the coarse nonplastics include, or are dominated by, rock fragments with inclusions of mica and dark minerals in an opaque white matrix. The clay matrix of the paste is coarse and granular, grading toward, but not intergrading with, the texture of the fine nonplastics. Eight samples of this paste class were selected for refiring and can be described as red or light red. Oxidized colors included 2.5YR 4/8 (1 sample), 2.5YR 5/8 (6 samples), and 2.5YR 6/8 (1 sample).

TABLE 5.1. Ceramic Materials from Washington City-Green Spring Site Collections.

Tradition / Type / Design Style	Sherd count (N)	Sherd count (%)	Weight (g)	Weight (%)
Indeterminate				
Plain gray utility	1	0.1	2	0.0
Southern Paiute				
Utility ware	623	48.5	3753	50.4
Shinarump				
Indeterminate ware	3	0.2	15	0.2
Indeterminate utility	10	0.8	65	0.9
Shinarump Brown	78	6.1	345	4.6
Shinarump Corrugated	210	16.4	1433	19.3
Smoothed, unpainted	7	0.5	46	0.6
Polished, unpainted	16	1.3	98	1.3
Slipped, unpainted	3	0.2	42	0.6
Virgin Black-on-white				
Dogoszhi	1	0.1	9	0.1
Virgin				
Indeterminate ware	5	0.4	9	0.1
North Creek Gray	185	14.4	925	12.4
North Creek Corrugated	19	1.5	104	1.4
Smoothed, unpainted	20	1.6	33	0.4
Polished, unpainted	18	1.4	94	1.3
Painted, not typable				
Indeterminate	16	1.3	34	0.5
Post-Kana'a	13	1.0	49	0.7
St. George Black-on-gray				
Black Mesa	7	0.5	53	0.7
North Creek Black-on-gray				
Dogoszhi	7	0.5	47	0.6
Sosi	2	0.2	12	0.2
Moapa				
Indeterminate ware	2	0.2	8	0.1
Boulder Gray	20	1.6	183	2.5
Moapa Corrugated	1	0.1	6	0.1
Smoothed, unpainted	1	0.1	8	0.1
Polished, unpainted	3	0.2	8	0.1
Painted, not typable				
Indeterminate	3	0.2	7	0.1
Post-Kana'a	3	0.2	12	0.2
Kayenta				
Tsegi Orange Ware	1	0.1	2	0.0
Fremont (?)				
Emery Gray (corrugated)	6	0.5	39	0.5
TOTAL	1284	100.0	7441	100.0

The characteristics of this paste class suggest the consistent use of a single clay type which varied selection and preparation of tempering material. The consistent appearance of the fine nonplastics regardless of the variation in the coarse nonplastics and their small size and roundness suggest that they are part of the clay itself and are not additions by the potter. This implies an alluvial source for the clay or a residual source that included eolian or alluvial materials at some stage of its development.

Southern Paiute pottery is described as being formed by paddle-and-anvil techniques with some use of scraping (Baldwin 1950:53; Fowler et al. 1973:16-17). Inferences of paddle-and-anvil technology are difficult to draw from the examination of individual sherds, but both interior and exterior sherds are expected to be smooth and facets may be present. Smooth interior surfaces are absent in the rockshelter collections, and many of the plain interior surfaces retain the parallel striations associated with scraping ("plain" surfaces are differentiated from "smooth" surfaces by degree of roughness). Smooth exterior surfaces are also absent, and although plain surfaces comprise 29.8 percent of the 621 sherds whose exterior surfaces could be observed, 68.0 percent of the exteriors were corrugated and 2.3 percent were clapboarded or ridged. Some of the corrugation consisted of fingernail indention or incision with a tool, but the vast majority of corrugation was accomplished by indentation of each coil as it was being applied to the vessel. Both corrugation and clapboarding are incompatible with paddle-and-anvil finishing techniques, and it is clear that the dominant vessel forming technique for the Southern Paiute sherds in the rockshelter collections was coil-and-scrape.

Surface colors of the Southern Paiute sherds are usually mottled ranging from black through brown to occasional dark or bright red. These variations are attributable to firing in most cases, although some of the apparent colors may have been affected by sooting during use. If the problem of potential postfiring sooting is ignored, the sherd colors suggest the following firing conditions:

reduction	156	25.0 %
poorly controlled reduction	25	4.0 %
neutral	134	21.5 %
poorly controlled neutral	3	0.5 %
oxidation	227	36.4 %
poorly controlled oxidation	78	12.5 %

Oxidizing firing conditions predominate and oxidation is assumed to be the intended firing regime. However, poor control is evident since half of the sherds exhibit characteristics of reducing or neutral conditions.

Southern Paiute vessel forms include bowls with rounded or pointed bases (small and large sizes), tall narrow jars that may have pointed bottoms (ollas in the terminology of this analysis), and large jars with very wide mouths (Baldwin 1950:54). These forms depart from traditional Anasazi forms in that the differences in shape between the wide orifice of the bowl and the more restricted orifice of the cooking/storage jar are blurred. Another departure is that Anasazi bowl interiors are usually much more carefully

smoothed or polished than are jar interiors, whereas the Southern Paiute bowl interiors (as identified on rim sherds) are not smoothed and are commonly as rough as jar interiors. This lack of smoothing limits the ability to distinguish jar from bowl body sherds during analysis. In the results reported here only sherds with extremely rough interior surfaces were classified as jar body sherds, and the remainder as bowl or jar body sherds. Another implication of the rough bowl interiors is that functional correlates (serving vs. cooking) may not have been as strong between bowl and jar forms in the Southern Paiute context as in Anasazi contexts. Bowl forms are commonly used for cooking outside of the Anasazi Southwest; such a use by the Southern Paiute is very likely.

Given these definitions, vessel form frequencies in the rockshelter collections are as follows:

bowl	5	0.8 %
bowl or jar rim	11	1.8 %
cooking/storage jar	6	1.0 %
cooking/storage jar or olla	5	0.9 %
jar body sherd	16	2.6 %
jar body sherd with handle stub	2	0.3 %
bowl or jar body sherd	574	92.1 %
other (possible canteen)	4	6.4 %

Both bowls and cooking/storage jar forms are definitely present in approximately equal numbers and these two forms probably account for nearly all of the remaining sherds. The existence of narrow-necked olla forms cannot be ruled out, but there is no positive evidence of their presence. In keeping with prior descriptions the orifices of the cooking/storage jars were large relative to vessel body diameter, and the shapes of bowls and jars were so similar that small rim sherds could not be confidently assigned to either category. Four unusual sherds are unlikely to have been derived from bowls or jars and may represent the remains of canteens. They are portions of cones, one of which was tipped with a round swelling that could accommodate a string attachment or sling.

Southern Paiute ceramics are generally assumed to be post-Anasazi in context. Most of the Southern Paiute sherds (75.3 percent) were recovered in collections from the modern ground surface outside the rockshelters while less than half of the Anasazi sherds (47.2 percent) were recovered from the surface collections.

Shinarump Ceramic Tradition

The second largest group of sherds in the rockshelter collections (N=328) is attributable to the Shinarump tradition (Table 5.1). These sherds correspond in paste characteristics to those described for Shinarump Gray Ware and White Ware by Colton (1952). Shinarump paste composition is similar to that of the Southern Paiute sherds in that there are two distinct classes of nonplastics, fine, and coarse. The fine fraction is consistent throughout all Shinarump sherds and consists of small (less than 0.20 mm diameter) rounded-to-subangular particles of mixed lithology. Opaque white particles are the most common, but transparent and dark minerals are always present.

The fine fraction is abundant but makes up a smaller proportion of the cross sectional area of each sherd than that of the Southern Paiute paste. Several distinctive suites of coarse nonplastics can be found in association with the fine fraction. The most common suite (85.4 percent) consists of sparse, coarse (0.5-1.5 mm diameter) subrounded-to-angular particles of mixed lithology. Clear (quartz) grains are present, but accompanied by opaque white and gray particles with occasional included mica. The second most abundant suite (9.1 percent) consists of clear rounded-to-angular particles and is similar to the coarse nonplastics found in the majority of non-Shinarump Anasazi sherds. The third suite (3.7 percent) includes distinctive aggregates of clear grains with a white cement (crushed sandstone). The aggregates are coarse and subrounded to subangular and can occur as a minority particle in association with the first suite, or as the predominant particle type in the coarse fraction. Other minority suites are crushed sherd in combination with clear subrounded to angular particles, and crushed sherd with clear particles within the sherd fragments. Accessory particles of crushed limestone were noted in many of these sherds, and the expansion of these particles during refiring damaged some of the samples.

The clay portion of the Shinarump pastes is less coarse than that of the Southern Paiute sherds but is coarser than other Anasazi pastes. This coarseness, combined with a slight tendency toward vitrification, often results in a sugary appearance when examined under the microscope. This distinctive texture is further emphasized by a higher iron content than in many Anasazi clays. This results in a light brown color under neutral conditions and a dark gray color under reducing conditions. After oxidation during refiring, most Shinarump pastes (77.8 percent of 36 samples) are red or light red in color (2.5YR 5/8, 2.5YR 6/8, 2.5YR 5/6, 2.5YR 6/6, 10R 6/6), and the remainder are yellowish red, reddish yellow, or reddish brown (5YR 5/8, 5YR 6/8, 5YR 7/6, or 5YR 5/4). Four slipped Shinarump sherds were included in the refiring analysis, and four different slip colors were recorded: 5YR 7/4, 7.5YR 7/4, 10YR 7/3, and 10YR 8/4. The inconsistency in these colors may be due to variable contamination of the slipped surface by soil chemicals, variable slip thickness, or to the use of different slip clays. However, in all cases, the slip clays are lighter in value and lower in chroma than the core clays and would provide a greater contrast with the black organic pigment used in painted decoration.

The brown appearance of the Shinarump paste and its contrast with the lighter paste characteristics of other Anasazi ceramic traditions has resulted in characterizing the Shinarump firing regime as poorly controlled oxidation (Colton 1952). Given that oxidation of the paste should produce red rather than brown colors, Shinarump sherds were described as reduced if gray or black in color, neutral if light brown, and oxidized if dark brown or red. These observations were tabulated across all of the Shinarump sherds with the following results:

reduction	22	6.7 %
poorly controlled reduction	1	0.3 %
neutral	259	79.0 %
poorly controlled neutral	12	3.7 %
oxidized	29	8.8 %
poorly controlled oxidation	5	1.5 %

Based on these data, it appears that a neutral firing atmosphere was consistently achieved and was probably the desired firing regime. This is more in accordance with the view that Shinarump sherds are part of the larger Anasazi ceramic tradition in which neutral firing predominates (for all but redware production), rather than being a deviant technological tradition.

Only three vessel forms are unequivocally represented in the Shinarump ceramics based on the following vessel form classes:

bowl	28	8.5 %
cooking/storage jar	25	7.6 %
cooking/storage jar or olla	21	6.4 %
jar body	249	75.9 %
bowl or jar body	4	1.2 %
miniature jar	1	0.3 %

Bowls are present as sherds from both unslipped and unpainted vessels and slipped and painted vessels. The only definite jar form present is the cooking/storage jar, most of which appear to have had orifice diameters of 10 cm or more. No rim or neck fragments could be interpreted as portions of ollas, although a single neck sherd had a radius of 3 cm and is assumed to be part of a miniature vessel. No slip or paint was present on any of the jar sherds. Although bowl sherds outnumber cooking/storage jar sherds, this is due to the policy of assigning body sherds to the bowl category if they are polished or decorated on their interior surfaces. A more correct inference is that as many as 90 percent of the Shinarump sherds are probably derived from cooking/storage jars and only about 10 percent can be attributed to bowls.

The typological composition of the Shinarump ceramics (Table 5.1) indicates that most of the sherds are debris from relatively late occupations. The single painted sherd with an adequate design area is decorated in Dogoszhi style, and clapboarded or indented sherds from corrugated vessels outnumber plain surfaced jar sherds by nearly 3 to 1 (210 to 76). Some of the plain sherds probably were derived from partially corrugated jars, but the presence of several plain rim and neck sherds does support the possibility of an earlier occupation.

Tusayan Gray Ware and White Ware: Virgin Series

The third most common ceramic tradition (287 sherds) includes sherds that conform generally to the description of the Virgin Series of Tusayan Gray Ware and White Ware (Colton 1952). Sherds assigned to this tradition are more heterogeneous in paste characteristics than those assigned to the other traditions, and in this sense the Virgin ceramic series serves as a catch-all in the classification system. It is likely that gray or whiteware sherds originating from the Kayenta Anasazi area, if present, have been arbitrarily included in this category.

The vast majority of these sherds (81.2 percent) are identified by the presence of coarse (0.5 to 1.0 mm diameter) predominantly clear subrounded-to-subangular particles (quartz). Within any given sherd some particles

may be frosted and some may have adhering cement (although aggregates were not observed). Nonplastics are usually abundant but there is considerable variation. The second most common suite of nonplastics (7.7 percent) is similar to the first suite but is much finer. Most of the clear particles are less than 0.3 mm diameter and individual particles may be difficult to distinguish if the paste is vitrified. The third major class of nonplastics (6.6 percent) consists of fine (0.2 to 0.5 mm diameter) opaque white subrounded particles with or without lesser amounts of clear subrounded particles. A minority class of nonplastics (2.1 percent) consists of coarse (0.4 to 1.0 mm diameter) subangular-to-subrounded particles of mixed lithology with few clear particles. Finally, three classes of nonplastics each comprise less than 1 percent of the total Virgin Series sherds. These are well rounded and frosted clear particles, crushed sherd and crushed sherd with subangular to subrounded clear particles.

All of these classes of nonplastics share a fine-grained relatively homogenous clay matrix. As a consequence the Virgin Series sherds appear distinctly different from the Southern Paiute and Shinarump pastes. There is no indication that any of the observed classes of nonplastics are genetically related to their associated clays, and it is likely that all of the nonplastics represent temper that was selected and added as part of the manufacturing process. Despite the apparent unity in paste texture, there is a relatively great diversity in paste composition as reflected in refired colors (Table 5.2). Most of the refired samples are light in color (value of 7 or greater), but hues range from 2.5YR to 2.5Y and chromas range from 1 to 8. The most common colors are very pale brown (10YR 8/4) and reddish yellow (7.5YR 8/6 and 5YR 7/6). Surprisingly, there does not appear to be any tendency for colors to cluster within a particular temper category except in the cases where there are only a small number of refired samples from a category.

Although the same range of vessel forms is present in both the Shinarump and Virgin Series sherds, frequencies of Virgin Series vessel form classes differ markedly:

bowl	79	27.5 %
cooking/storage jar	9	3.1 %
cooking/storage jar or olla	12	4.2 %
jar body	178	62.0 %
jar body with handle stub	1	0.3 %
bowl or jar body	7	2.4 %
miniature jar	1	0.3 %

Bowl sherds are three times as abundant within the Virgin Series sherds, accounting for as much as 30 percent of the ceramic collection as opposed to 10 percent for the Shinarump tradition. Most of the bowl sherds (75.9 percent) are polished or painted and derived from whiteware vessels. Three sherds are clearly from grayware bowls, and the remainder are smoothed but not polished and could be derived from either grayware or some whiteware vessels. The jar category appears to be wholly derived from cooking/storage jars with no positive indications that olla forms are present. Three of the jar sherds are polished and could have come from unpainted portions

TABLE 5.2. Refired Paste Colors for Virgin Series Samples.

Hue	Value/Chroma	Number of Samples
2.5YR	6/8	1
5YR	6/6	2
	6/8	3
	7/6	7
	7/8	4
	8/4	1
7.5YR	7/6	3
	8/6	7
	9/6*	2
10YR	7/4	1
	8/4	9
	9/4*	2
2.5Y	9/1*	1

*Sample color was beyond the range of the reference used, and the color listed is an extrapolation from the nearest color.

of whiteware vessels, but no painted decoration was noted on any jar sherds. The single miniature vessel is a fragment of a very small jar rim with slight polish on the interior of the neck.

Stylistic characteristics of the Virgin Series sherds encompass the same range as the Shinarump sherds but have some quantitative differences (Table 5.1). Both corrugated and plain gray ware sherds are present, but the plain sherds are much more abundant (the reverse of the Shinarump tradition sherds). In addition, the styles of manipulation within the corrugated category have different emphases. Filleting or clapboarding is exclusively present on 26.2 percent of the Shinarump Corrugated sherds but accounts for only 5.3 percent of the Virgin Series. This difference in execution could result from any number of factors, but it does emphasize that these two sets of sherds are unlikely to be the products of the same potters using different resources at different times. Painted designs all appear to correspond to the Black Mesa, Sosi, and Dogozshi styles, with no indication of earlier or later decorated vessels. These styles require occupation of the rockshelters within the Pueblo II period, and the high frequency of plain grayware sherds suggests that there may have been earlier occupations as well.

Moapa Ceramic Tradition

The Moapa category is defined to accommodate sherds in the Virgin Anasazi region having a very distinctive olivine temper but similar to Virgin Series sherds in other respects (Colton 1952). Rockshelter collections include 33 sherds that conform to this definition. The nonplastics are pale green to black, transparent, subangular-to-angular olivine particles that may range in size from fine to coarse (0.1-1.0 mm diameter). Except in color the particles are similar to angular examples of the major temper class within the Virgin Series pastes.

Clay use differs from the Virgin Series pastes in that most Moapa examples are slightly silty, midway in characteristics between the Virgin and Shinarump modes. Refiring reveals a predominance of light colored clays, most of which (91.3 percent of 23 samples) have a color value of 8 or higher. The values of seven sherds were so high that they were beyond range of the Munsell Soil Color charts and had to be extrapolated. Unlike the Virgin Series samples that spanned five hues, the Moapa samples were relatively homogeneous and encompassed only three hues (5YR, 7.5YR, and 10YR). Over half of the refired sample colors (12 sherds) correspond to very pale brown, and six correspond to reddish yellow. These results are more diverse than the extremely similar clay sources used in the manufacture of Southern Paiute and Shinarump vessels, but there is greater similarity than within the less precisely defined Virgin Series samples.

The range of vessel forms represented in the Moapa sherds is similar to that of the other Anasazi ceramic traditions, but there are fewer specific form classes present due to the smaller sample size:

bowl	9	27.2 %
cooking/storage jar or olla	3	9.1 %
jar body	17	51.5 %
bowl or jar body	4	12.1 %

Relative frequencies of the different vessel classes are more similar to the Virgin Series sherds than to the Shinarump sherds due to an abundance of bowls. The bowl sherds are all polished or painted and are undoubtedly derived from whiteware vessels, while all jar sherds are neither polished nor painted. The presence of cooking/storage jars within the grayware category is likely but cannot be confirmed, and the presence of sherds from ollas cannot be ruled out.

The surface areas of the few painted sherds were too small to allow specific stylistic classification, but two had designs that were clearly post-Kana'a in affiliation. Within the graywares, one corrugated sherd was present as opposed to 20 plain gray sherds. The scarcity of corrugation is unlike the Shinarump sherds and is similar to stylistic frequencies within the Virgin Series. Thus, the Moapa sherds provide support for the possibility of a pre-Pueblo II occupation as well as for the presence of a Pueblo II occupation.

Kayenta Tradition

A single unpainted sherd from a Tsegi Orange Ware bowl was recovered in the rockshelter collections. Nonplastics are crushed potsherd particles, and the source of the temper appears to have been quartz sand tempered (probably Tusayan) gray or whiteware sherds. This sherd cannot be classfied as to type due to the lack of painted design, but its presence is compatible with the Pueblo II period of occupation.

Fremont (?) Tradition

Six sherds do not fit into any of the previously defined ceramic traditions. These sherds have nonplastics consisting of subrounded to angular, gray-to-black, opaque particles ranging in size from 0.2 to 1.5 mm diameter. The black particles are fine-grained and could be a crushed claystone, metamorphic rock, or aphanitic igneous rock. Two examples were refired and the pastes are red and reddish yellow (2.5YR 5/8 and 5YR 6/8). These colors are similar to those of the Shinarump and Southern Paiute sherds, but the sherds lack the sugary granularity of the Shinarump examples and the accessory fine sand nonplastics of the Southern Paiute examples. All six are from a single site, all are corrugated jar body sherds, and all could be derived from the same jar.

The interpretation of these sherds as being Fremont in affiliation is tentative. Fremont ceramics can include a gray to black basalt temper and can be made of clays that approach red or reddish yellow in color (Madsen 1977). However, these characteristics are not specifically associated with the type of Fremont corrugated vessel usually found in the southwestern Utah area (Snake Valley Corrugated). Instead, if these sherds do represent a Fremont tradition vessel, they would have to be from a rare corrugated example of Emery Gray which is described as originating in south central Utah (Madsen 1977:10, 31-32).

Intersite Comparison and Discussion

The distribution of ceramics among the Washington City-Green Spring site collections is uneven in both total collection size and in aspects of collection content (Table 5.3). Some of this spatial variability is probably due to different levels of excavation and collection effort or to differences in excavation strategy, but for the purposes of this discussion these potential biases are ignored, and the site collections are assumed to be comparable in both quantitative and qualitative senses.

Southern Paiute Occupations

All of the five ceramic-bearing rockshelters and the outdoor hearth features provide some evidence of Southern Paiute occupation. The intensity of this occupation is highly variable, as shown by different quantities of sherds; these range from 491 sherds in Site 42WS1629 to single sherds in Sites 42WS1633 and 42WS1828. The heaviest or most repeated occupations were within Sites 42WS1629 and 42WS1632. The functional nature of the Southern

TABLE 5.3. Ceramic Materials by Site (Page 1 of 2).

Tradition / Type / Design style	Site 42WS1629 (%)	42WS1630 (%)	42WS1631 (%)
Indeterminate			
Plain gray utility	0.1		
Southern Paiute			
Utility ware	61.5	18.6	65.5
Shinarump			
Indeterminate ware			
Indeterminate utility	0.4		
Shinarump Brown	4.5	7.0	3.4
Shinarump Corrugated	8.3	9.3	20.7
Smoothed, unpainted			
Polished, unpainted	1.8		
Slipped, unpainted	0.3		
Virgin Black-on-white			
Dogoszhi			
Virgin			
Indeterminate ware	0.3		
North Creek Gray	13.3	32.6	6.9
North Creek Corrugated	0.6		
Smoothed, unpainted	1.5	7.0	
Polished, unpainted	1.3	9.3	3.4
Painted, not typable			
Indeterminate	1.8		
Post-Kana'a	0.8		
St. George Black-on-gray			
Black Mesa		16.3	
North Creek Black-on-gray			
Dogoszhi	0.5		
Sosi			
Moapa			
Indeterminate ware	0.3		
Boulder Gray	1.4		
Moapa Corrugated	0.1		
Smoothed, unpainted	0.1		
Polished, unpainted	0.3		
Painted, not typable			
Indeterminate	0.1		
Post-Kana'a	0.4		
Kayenta			
Tsegi Orange Ware			
Fremont (?)			
Emery Gray (corrugated)	0.8		
Sample Size	799	43	29

Table 5.3. Ceramic Materials by Site (Page 2 of 2).

Tradition / Type / Design style	Site 42WS1632 (%)	42WS1633 (%)	42WS1828 (%)
Indeterminate			
Plain gray utility			
Southern Paiute			
Utility ware	26.8	5.0	12.5
Shinarump			
Indeterminate ware	0.8		
Indeterminate utility	1.6	5.0	
Shinarump Brown	9.6	5.0	
Shinarump Corrugated	31.7	60.0	
Smoothed, unpainted	1.8		
Polished, unpainted	0.3		12.5
Slipped, unpainted	0.3		
Virgin Black-on-white			
Dogoszhi	0.3		
Virgin			
Indeterminate ware	0.3		25.0
North Creek Gray	15.1	15.0	25.0
North Creek Corrugated	3.4	5.0	
Smoothed, unpainted	1.3		
Polished, unpainted	0.3	5.0	12.5
Painted, not typable			
Indeterminate	0.5		
Post-Kana'a	1.6		12.5
St. George Black-on-gray			
Black Mesa			
North Creek Black-on-gray			
Dogoszhi	0.8		
Sosi	0.5		
Moapa			
Indeterminate ware			
Boulder Gray	2.3		
Moapa Corrugated			
Smoothed, unpainted	0.3		
Polished, unpainted			
Painted, not typable			
Indeterminate	0.5		
Post-Kana'a			
Kayenta			
Tsegi Orange Ware	0.3		
Fremont (?)			
Emery Gray (corrugated)			
Sample size	385	20	8

Paiute occupation appears to have been a base camp or habitation at which there was frequent preparation of boiled foods. The cooking/storage jar forms have such large orifices that long term storage functions are unlikely due to a high degree of difficulty in sealing or securing the vessel contents. Since the bowls were probably used for cooking also (at least occasionally), distinctions between bowl and jar frequencies cannot be interpreted confidently and are not presented for the different sites. As mentioned previously, most of the Southern Paiute sherds were recovered from surface as opposed to subsurface contexts, and those from subsurface proveniences are assumed to have been mixed downward during disturbance of the rockshelter deposits by the late occupations.

Anasazi Occupations

Like the Southern Paiute occupation, all of the ceramic-bearing rockshelters provide evidence of Anasazi use. The heaviest or most repeated use occurred at Sites 42WS1629 and 42WS1632 with only minor use of the other four sites (Table 5.3). Anasazi occupation appears to have spanned a considerable period of time, with some variation in the use histories of the sites. The combined collections indicate base camp or seasonal habitation rather than long-term habitation due to the absence of vessel forms other than bowls and cooking/storage jars.

The strongest evidence for mixture of several temporally distinct Anasazi occupations comes from the combined site collections (Table 5.1). The typological composition of the combined collections is unlike the typological composition of presumably single component site collections from the Walhalla Plateau, Grand Canyon, Arizona (Schwartz et al. 1981:table 11). Collections attributed to the A.D. 950-1050 period have more plain than corrugated grayware sherds and include small amounts of neckbanded as well as stylistically early whiteware types. After A.D. 1050, corrugated sherds outnumber plain grayware sherds by at least 4 to 1 and in some cases as many as 8 to 1. Neither of these two patterns of early vs. late sherds can account for the rockshelter collections as a whole, and they appear to be mixtures of occupation debris spanning a long period of time.

All of the collections include corrugated or stylistically late whiteware ceramics, providing a confident indication of late (Pueblo II) occupations of the sites. Plain gray ceramics are also present in the sites, but the sample sizes for four of the sites (42WS1630, 42WS1631, 42WS1633, and 42WS1828) are too small to claim that an early occupation is definitely represented. The ambiguity of an early occupation in the four cases is due to the presence of low frequencies of plain grayware sherds in pure late ceramic assemblages. These expected low frequencies and the uncertainty associated with proportions based on small collection sizes (all less than 50 sherds in these sites) mean that the few plain grayware sherds could be accounted for by a late occupation.

Problems with the uncertainty of proportions are less significant in discussing the much larger collections from sites 42WS1629 and 42WS1632. In both sites, plain grayware is more common than would be expected if the collections were produced by late occupations only (assuming that the relationships observed in the Grand Canyon collections are applicable to late ceramic

assemblages in the Washington City area). The largest ratio of corrugated to plain gray sherds is 1.3 to 1 in the 42WS1632 collection, falling far short of the 4 to 1 expectation, and the collection from 42WS1629 has more plain grayware than corrugated sherds. Thus, although the late occupations are superficially obvious at both sites, there appears to have been considerable use of Site 42WS1629 prior to the Pueblo II period and a less intense but still noticeable early occupation of Site 42WS1632 as well. The relative preference for the two sites was reversed in the Pueblo II occupation, with more intense occupation within Site 42WS1632. Due to the absence of neckbanded sherds and of early styles of painted ceramics, the dating of the early occupation could be prior to Pueblo I, but this inference is weak due to the small number of early sherds present.

These temporal differences in rockshelter occupation intensity are also reflected differences in the ceramic traditions within the two large collections. The earlier occupants discarded large amounts of Virgin Series ceramics, resulting in a slight concentration of Virgin and Moapa sherds at Site 42WS1629. The later occupants contributed more Shinarump than Virgin pottery, resulting in a concentration of Shinarump ceramics at Site 42WS1632. These trends could be interpreted as reflecting changing cultural affiliation of site occupants across the Pueblo II threshold, but this inference is tentative without additional evidence that the two traditions actually represent different human populations.

The temporal differences may also contribute to the explanation of Anasazi vessel form variations between the site collections (Table 5.4). Again, the small samples from four of the rockshelters preclude meaningful discussion of those collections, but the collections from Sites 42WS1629 and 42WS1632 can be compared. The major difference between the two sets of vessel form frequencies is a greater frequency of bowls in the 42WS1629 collection as opposed to more jar sherds at 42WS1632. Unfortunately, individual sherds from the "early occupation" cannot be reliably identified, and we must assume rather than demonstrate that the observed differences in vessel form frequencies are due to variances in vessel use during the early occupation as compared to late occupations. It is unlikely that food consumption activity (bowl breakage) would occur in the absence of food preparation and storage activity (jar breakage), but the converse is possible if food were being gathered at the rockshelters for transport elsewhere for later consumption. Given these assumptions, it is possible that the early uses of the rockshelters were oriented more toward seasonal habitation and the later uses were more single-purpose as in a camp for procurement of a specific set of storable resources.

Summary and Conclusion

At least five, perhaps six, ceramic traditions are represented in the collections from the Washington City-Green Spring sites. Southern Paiute sherds are most common, followed by the Shinarump, Virgin, Moapa, Kayenta, and possibly Fremont traditions. The Virgin Series is defined to encompass a wide variety of paste types, which could include sherds derived from other areas of the Southwest (such as Tusayan Gray Ware and Tusayan White Ware). The possible Fremont sherds have a dark angular temper (basalt?) in a red-firing clay and are only weakly inferred to be Fremont in affiliation.

TABLE 5.4. Anasazi Vessel Form Frequencies by Site.

Vessel Form Class	Site 42WS1629 (%)	42WS1630 (%)	42WS1631 (%)
Bowl	21.1	31.4	10.0
Cooking/storage jar	1.6		
Cooking/storage jar or olla	7.5	2.9	
Jar body	66.6	51.4	80.0
Bowl or jar body	2.6	14.3	10.0
Miniature jar	0.6		
Jar body with handle stub			
Sample Size	308	35	10

Vessel Form Class	Site 42WS1632 (%)	42WS1633 (%)	42WS1828 (%)
Bowl	12.8	5.3	42.9
Cooking/storage jar	9.2	15.8	
Cooking/storage jar or olla	4.3		
Jar body	72.0	73.7	28.6
Bowl or jar body	1.4	5.3	28.6
Miniature jar			
Jar body with handle stub	0.4		
Sample Size	282	19	7

At least three broad periods of occupation are indicated by the ceramics. An early use pre-dates the Pueblo II period; activities were concentrated at Site 42WS1629, included Site 42WS1632 as well, and may also have involved limited use of the other rockshelters. Occupants of the sites during this period carried more Virgin and Moapa tradition ceramics than Shinarump vessels. Comparatively more bowls were broken during the early occupation than in the Pueblo II period, perhaps as a result of longer term and more generalized use of the shelters as seasonal habitations.

All of the rockshelters except 42Ws1634 were in use within the Pueblo II period, but occupation was more intense at Site 42WS1632 than at Site 42WS1629, and the other rockshelters were only lightly used. Shinarump tradition vessels were most common during this period (except for bowls which tend to be from other traditions), and relatively more jars were broken than during the previous period of occupation. This emphasis on jars reflects a narrowing of the range of activities performed at the sites and may reflect a change in the pattern of use from seasonal habitation to seasonal camp.

The final occupation is that of the Southern Paiute, and in terms of volume of pottery breakage, this occupation may have been as intense as the preceding Anasazi occupations combined. However, since most of the Southern Paiute sherds were recovered from surface collections, the absolute abundance of this tradition may be over-represented as a result of their stratigraphic position.

CHAPTER VI

LITHIC ARTIFACT ANALYSIS

Introduction

Approximately 448 lithic artifacts were recovered from the seven Washington City-Green Spring sites. In part, these constitute four gross functional categories consisting of grinding, cutting/ scraping, piercing, and pounding/ crushing implements. Overall, debris from the production and maintenance of stone tools comprises the majority of the lithic artifacts (78%). The remaining 22% consist of complete and fragmentary stone tools. It is believed that the lithic assemblage obtained from each site is representative, though not in a probablistic sense, of the total nonperishables discarded at every site. In all cases, each site was thoroughly excavated and major portions of their trash deposits recovered.

As stated in Chapter III, the lithic analysis format was designed to meet the needs of the project research design. Accordingly, the major goals of the lithic analysis were to determine the types of activities undertaken on the sites, identify tool kits and how they relate to specific subsistence resources obtained by the prehistoric inhabitants, and to observe changes in lithic technology as reflected through time in response to the needs generated by different subsistence strategies. In order to address these goals, analytical methods were designed to provide inferences about three behavioral realms: lithic function, technological/production techniques, and material selection.

The function of lithic tools was approached with full realization of the complexities and often arcane nature of use-wear analysis. The collection was studied using a technomorphological classification and a rather generalized attribute analysis of edge damage patterns. Examination of edge damage employed a "low-power" approach which focuses primarily on microflaking and abrasion on the edges of tools (Tringham et al. 1974; Odell 1979, 1981; Odell and Odell-Verceecken 1980). The edges of specimens were routinely checked with a hand lens and, when necessary, use-wear was verified using a binocular microscope capable of magnification as high as 40X.

The analysis of production techniques is pertinent to typology, for detailed analysis of the various stages of the manufacturing process can give clues to technique and functional need (Crabtree 1972:3). Technological and morphological descriptions of lithic specimens followed relatively standard procedures and terminology (Holmes 1919; Crabtree 1972; Tixier 1974). Classification of artifacts into distinct typologies was based on shared morphological and utilization attributes. In cases where too few artifacts were found to justify a typology, individual artifacts were separately described. All measurements are given in millimeters. Unless otherwide shown, all illustrations are actual size.

The prehistoric selection of raw materials for chipped stone tools constitutes the third behavioral realm. The identification of an actual or possible geologic source locality is extremely useful for interpreting material procurement strategies and also provides an invaluable insight into exchange strategies and relationships. Consequently, one aspect of this study was to identify, locate, and sample lithic materials used by the past inhabitants of the Washington City-Green Spring sites. Some geologic source localities within the St. George Basin have been identified by past researches so that general geologic occurrences of several material categories are known. One raw material type commonly found on the sites was obsidian. Five samples were submitted to A & G Analyses of Provo, Utah for identification of geologic sources based upon chemical composition (Appendix E).

The raw lithic material types locally found within the Washington City-Green Spring area encompass a wide variety of chert, chalcedony, jasper, and quartzite. Within the St. George Basin proper, numerous deposits of graded gravels containing quartzite cobbles, and cryptocrystalline nodules occur along major stream channels and ridge slopes (Gardiner Dalley, BLM Cedar City, personal communication 1986). The texture of these assorted material types varies from a gritty, brittle, calcareous medium-textured rock to a fine-grained, vitreous quality. At the Red Cliffs Site, located 6 air miles northeast of Washington City, Dalley and McFadden (1985:17) report the local availability of numerous quartzite cobbles and occasional cryptocrystalline silicates in the gravels on ridge flanks and along Leeds Creek.

Another raw material type present in the general region, but not locally found in the Washington City-Green Spring area, is obsidian. Obsidian outcrops are known to occur in western Iron, southern Beaver, and northern Washington Counties in what is known geologically as the Tonoquints Volcanic Section (Stokes 1977). Known archaeological obsidian source localities in Utah have been reported near Modena in western Iron County and in the Mineral Mountains east of Milford (Gardiner Dalley, BLM Cedar City District: personal communication). Known archaeological obsidian source localities in southeastern Nevada have been reported near Kane Springs Wash, Lincoln County (Tucker 1985:120). Two other obsidian types have been identified by Dr. Fred Nelson of A & G Analyses of Provo, Utah. These two types, labeled Source A and Source B, display different chemical compositions from the above mentioned geologic sources; however, their source locations are unknown (Dr. Fred Nelson, A & G Analyses, personal communication). A final obsidian source area which has just recently been recognized in minor amounts from prehistoric artifact assemblages from southwest Utah is Government Mountain-Sitgreaves Peak (Nelson: personal communication). This source area is located 30 kilometers northwest of Flagstaff, Arizona.

Selected material types for ground stone implements consist mainly of tabular sandstone slabs, basalt, and granite, all of which occur within close proximity to the project area (Dalley and McFadden 1985:17). Tabular pieces of sandstone, mostly derived from the Kayenta Formation, were commonly used for grinding slabs, while vesicular basalt and quartzite appear to have been preferred materials for handstones.

It appears that within the Washington City-Green Spring region, quartzites and cryptocrystalline silicates of diverse physical characteristics are abundant and generally easily accessible for use in the manufacture of stone tools. In such circumstances, Geib (1985: 320) has hypothesized that raw material selection for tool types was largely conditioned by the relationship of grain size and siliceousness with regard to functional suitability. Simply stated, as grain size increases, there should generally be a change in the utilization of resources for work such as cutting, piercing, and scraping to tougher tasks such as grinding, pounding, chopping, and abrading. Preferred selection of fine to coarse-grained raw material types for specific tool classes should reveal different technological treatments of raw material resources.

The following section defines and discusses the different types of stone tools and debitage recovered from the Washington City-Green Spring project. The artifact designation method is binomial. For example, Artifact No. 42Ws1629-114 indicates Field Specimen No. 114 from Site 42Ws1629.

Flaked and Abraded Stone Tools

Projectile Points

The term projectile point refers to relatively small, thin, bifacially flaked tools which exhibit a point at the distal end (except where broken or reworked) and special modification of the proximal end to produce a haft. A total of 14 projectile points were recovered from the Washington City-Green Spring project. Projectile point types are described by stylistic, morphological, and metric attributes. Typology is based on selected morphological traits established by Thomas (1970, 1981) and Holmer (1978, 1986). Thomas (1970, 1981) has identified sets of selected morphological traits used with success in building a chronology for the central and western Great Basin while Holmer (1978, 1986) devised a similar methodology for classifying points from the eastern Great Basin and northern Colorado Plateau.

Eastgate Expanding Stem

2 Specimens: Artifact 42Ws1629-114 and 42Ws1632-72 (Figure 6.1)

These two triangular points are notched rather than truly stemmed using Holmer's (1986:94) criteria. Morphologically they might be described more accurately as basally-notched than stemmed. In both cases, the stem is square with a straight base. On one specimen (42Ws1632-72), moderately deep oblique notches occur at the base near the corner, forming prominent tangs, while on the other specimen (42Ws1629-114), the oblique notches are rather shallow. Overall, the blade is relatively short and wide, with convex margins. Both specimens were made by very fine bifacial pressure flaking.

Comparable Specimens: Fowler, Madsen and Hattori (1973:27), Lanning (1963: 253), Jennings (1957:129)

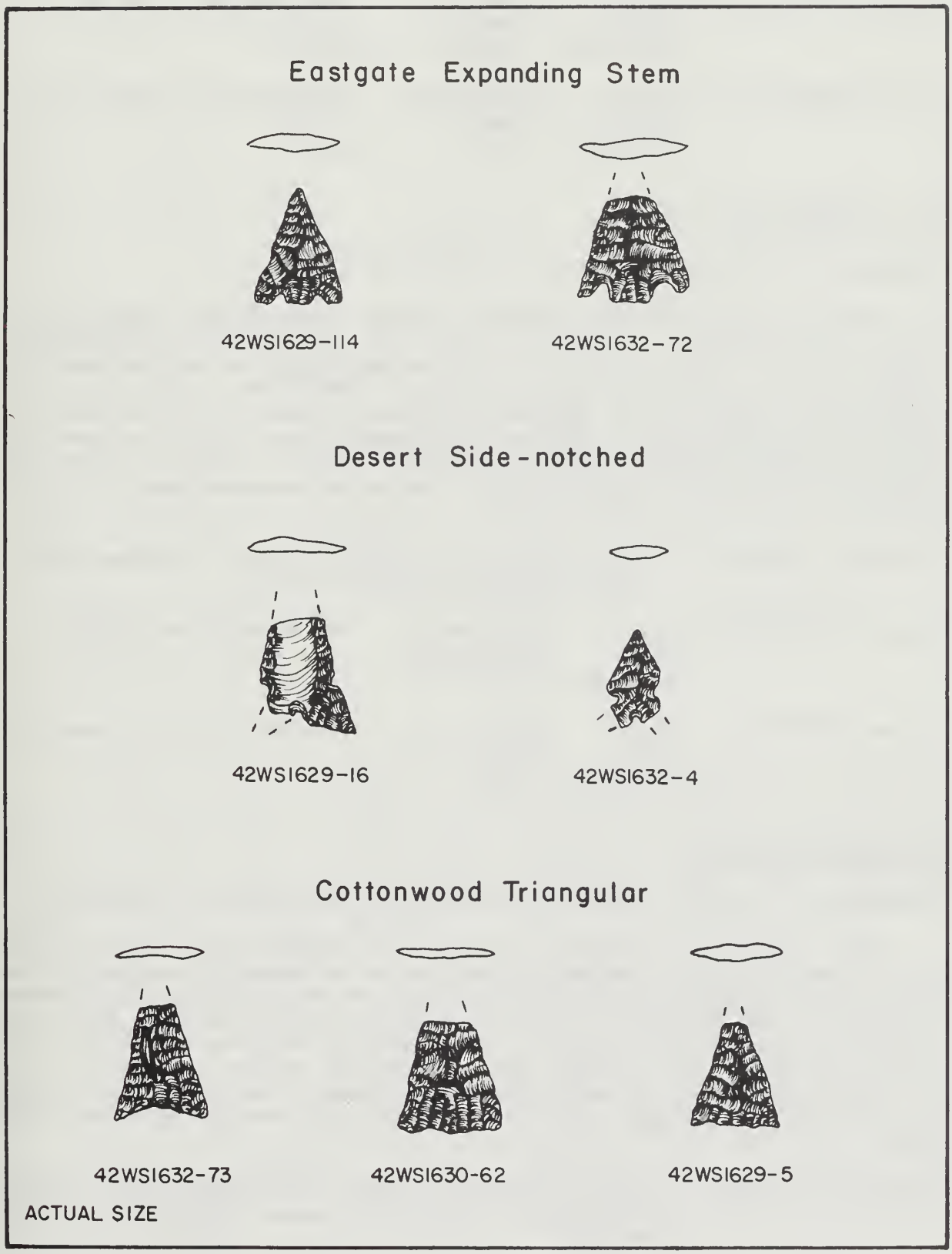


FIGURE 6.1. Projectile Points. Top row: Eastgate Expanding Stem; middle row: Desert Side-Notched; bottom row: Cottonwood Triangular.

Artifact 42Ws1629-114:	Length:	19 mm	Raw Material: Obsidian
	Width:	15 mm	
	Thickness:	3 mm	
Artifact 42Ws1632-72:	Length:	Indeterminate	Raw Material: White chert
	Width:	20 mm	
	Thickness:	4 mm	

Desert Side-Notched

2 Specimens: Artifact 42Ws1629-16 and 42Ws1632-4 (Figure 6.1)

Both of these points are fragments; however, both display enough morphological and stylistic attributes to positively aid in their classification (Holmer 1986). Both points are small triangular forms with straight to slightly concave blade margins. Artifact 42Ws1629-16 displays high side notches and a base that is concave and deeply notched. The one remaining expanding spur is pointed. The point was manufactured out of a flake with minimal retouch flaking. Artifact 42Ws1632-4 exhibits relatively low side notches and slightly parallel spurs. The point was made from a bifacial preform.

Comparable Specimens: Fowler, Madsen and Hattori (1973:27), Lanning (1963: 253), Baumhoff and Byrne (1959:38)

Artifact 42Ws1629-16:	Length:	Indeterminate	Raw Material: White chert
	Width:	Indeterminate	
	Thickness:	3.5 mm	
Artifact 42Ws1632-4:	Length:	18 mm	Raw Material: White chert
	Width:	Indeterminate	
	Thickness:	3 mm	

Cottonwood Triangular

3 Specimens: Artifact 42Ws1632-73, 42Ws1630-62, and 42Ws1629-5 (Figure 6.1)

Small unnotched triangular points with maximum width near the base and straight to concave base were classified as Cottonwood Triangular (Holmer 1986). Blade margins are generally straight but vary slightly from concave to convex on two specimens. Two of the points exhibit straight bases with slightly rounded corners. Artifact 42Ws1629-5 differs from the other points in that instead of a straight base and rounded corners, it exhibits a 1 mm deep basal concavity and sharp corner tangs. Two of the points were made from thinned preforms and one from a minimal pressure retouched flake blank.

Comparable Specimens: Lanning (1963:252), Holmer (1986:108), Fowler, Madsen and Hattori (1973:22), Thomas (1984:15-16), Dodd (1982:73).

Artifact 42Ws1632-73:	Length:	17 mm	Raw Material: White chert
	Width:	15 mm	
	Thickness:	4 mm	
Artifact 42Ws1630-62:	Length:	Indeterminate	Raw Material: Obsidian
	Width:	17 mm	
	Thickness:	3 mm	
Artifact 42Ws1629-5:	Length:	Indeterminate	Raw Material: Mottled
	Width:	15 mm	whitish gray chert
	Thickness:	2 mm	

Large Miscellaneous Points

Artifact 42Ws1629-105 (Figure 6.2)

This large lanceolate fragment consists of the lower midsection and upper base. Blade outline is straight to slightly concave. Though the lower base is missing, the point appears to have been corner-notched, with slightly expanding shoulder tangs. Stylistically, the point is within the range of an Elko Corner-Notched type (Jennings 1978:64). Extensive rounding, polish, and bifacial microflaking on one lateral margin indicates that the point was used as a hafted knife.

Length:	Indeterminate	Raw Material: Tan-colored chert
Width:	22 mm	
Thickness:	5 mm	

Artifact 42Ws1633-94 (Figure 6.2)

Artifact 94 is a reworked, stemmed, triangular/lanceolate projectile point. The artifact exhibits a thick biconvex transverse cross-section with soft hammer bifacial thinning and pressure-flaked longitudinal thinning along the base. The incurvate blade margins have been roughly reworked. Other attributes are sloping shoulders with relatively straight tangs and a convex base. Stylistically, the artifact is similar to a Gypsum point (Fowler, Madsen and Hattori 1973:20).

Length:	42.5 mm	Raw Material: Whitish gray chert
Width:	20.5 mm	
Thickness:	6 mm	

Artifact 42Ws1630-16 (Figure 6.2)

Snapped at the midsection and longitudinally at the base, this artifact is a large corner-notched projectile point/knife base. The tool displays a thin, biconvex, transverse cross-section with very fine bifacial thinning; light polish occurs in both the broad, deep notch and along the base margin, suggesting possible wear from hafted use.

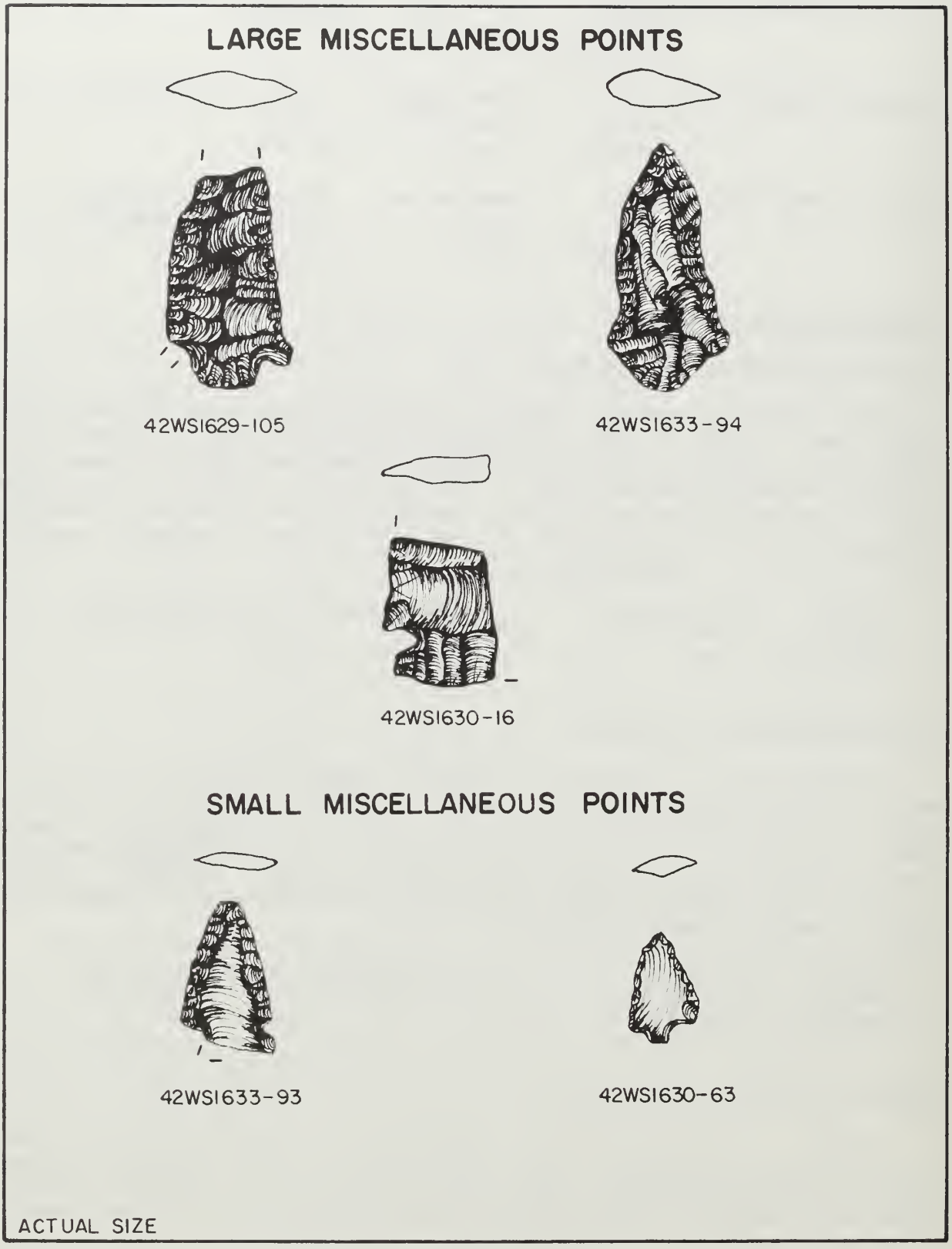


FIGURE 6.2. Large and Small Miscellaneous Projectile Points.

Length: Indeterminate
Width: Indeterminate
Thickness: 5 mm

Raw Material: Obsidian

Small Miscellaneous Points

Artifact 42Ws1633-93 (Figure 6.2)

This artifact is a side-notched projectile point fragment with the lower portion of the base missing. The point was manufactured from a thin, bifacial thinning flake and exhibits minimal bifacial pressure retouch along the margins. With no use-wear, the artifact was probably broken during manufacture. Although stylistically indeterminate, it is felt to be Late Protohistoric due to its crude workmanship and expedient nature.

Length: Indeterminate
Width: 16 mm
Thickness: 1.5 mm

Raw Material: Red chert

Artifact 42Ws1630-63 (Figure 6.2)

This specimen is morphologically similar to Artifact 42Ws1633-93 in that it was manufactured from a thin bifacial thinning flake and exhibits minimal bifacial pressure retouch along margins. Pressure retouch appears to have been directed more at shaping the flake into a pointed projectile than creating sharp sinuous edges, judging by the extensive step-flaking and crushed manufacturing edge damage. The base element is short and stemmed. This artifact is also felt to be Late Protohistoric.

Length: 18.5 mm
Width: 12 mm
Thickness: 2 mm

Raw Material: Red chert

Indeterminate Fragments

2 Specimens: Artifacts 42Ws1632-71 and 42Ws1633-92

This group consists of projectile point fragments too indeterminate in both morphological and stylistic attributes to identify conclusively. They include two obsidian tip fragments. One fragment, Artifact 42Ws1633-92, was submitted to A & G Analyses for identification of geologic source based upon chemical compositions. The obsidian used to manufacture the projectile was derived from the Wild Canyon area, Mineral Mountain Range, Beaver County, Utah (see Appendix E).

Bifaces

12 Specimens

The term biface is used here to refer to all specimens flaked on both the obverse and reverse faces. Excluded from consideration are all relatively small, thin, bifacially flaked items which possess a sharp point on one end and a haft element on the opposite end. These artifacts have been described separately as projectile points.

Twelve bifaces constitute this category. All of the specimens are fragments too indeterminate in both morphological and stylistic attributes to place into distinct typologies; however, enough basic attributes do exist to discuss the collection as a whole. The biface fragments consist of 1 tip, 7 midsections and 4 base fragments. The midsection fragments are rather uniformly thin and display biconvex transverse cross-sections. Overall, the midsection fragments exhibit straight, parallel lateral edges indicating either a former lanceolate or leaf shape. The faces of the majority of the midsection fragments have been thinned by well-controlled parallel flaking, mostly soft hammer percussion. Edge wear damage on 5 of the midsections is extensive, indicating several episodes of resharpening, with slight crushing, attrition, and bifacial microflaking. Six of the midsections display transverse snap fractures probably caused by breakage during utilization. Three of the basal fragments exhibit convex bases while the fourth is relatively straight with slightly rounded corners. Transverse cross sections range from thin biconvex to thick lenticular. Three of the base fragments display heavy edge abrasion and a glossy polish indicating that the specimens may have been hafted.

Average Measurements:	Length:	Range:	Indeterminate
		Mean:	Indeterminate
	Width:	Range:	30-23 mm
		Mean:	28.3 mm
	Thickness:	Range:	10-3.5 mm
		Mean:	7 mm

Raw Material: 11 Whitish gray chert
1 Brown chalcedony

Scrapers

4 Specimens: Artifacts 42Ws1629-10, 42Ws1632-60, 42Ws1632-21, and 42Ws1630-61 (Figure 6.3)

Scrapers are characterized by a convex edge with a flat ventral surface and a steep to moderately steep edge angle. Three of the four scrapers are primary or secondary quartzite cobble decortication flakes, roughly oval in shape, which have been retouched to form convex bits that are irregular or jagged in outline. Edge angles on the bits range between 50°-70°, but

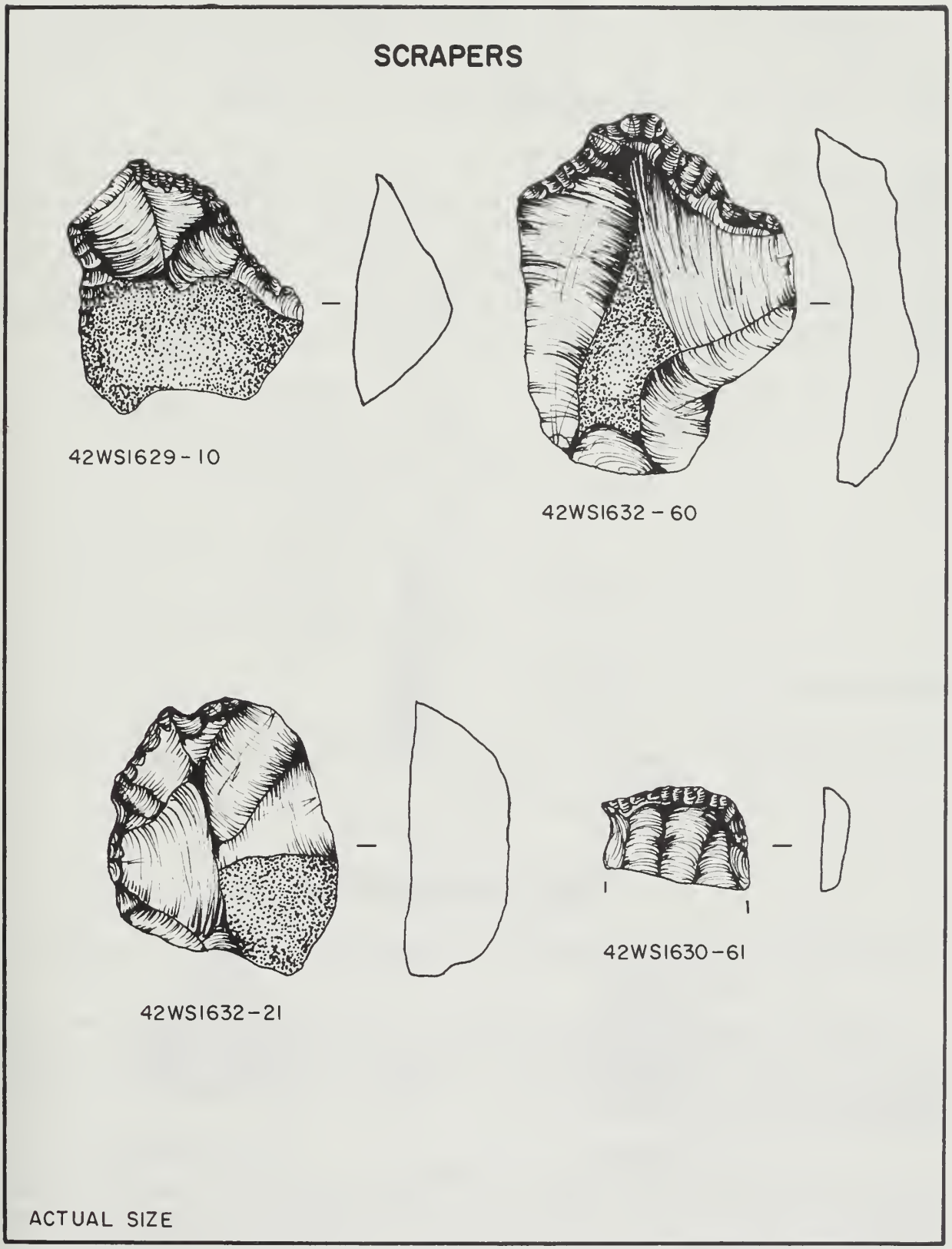


FIGURE 6.3. Scrapers.

vary considerably along a single edge. Edge damage is evident on two of the specimens, consisting of an undercut with numerous step fractures at the juncture of the bit with the plano surface and glossy polish on bit projections. The presence of use polish on the two implements is tentatively associated with either hide working or soft wood working (Crabtree and Davis 1968; Tringham et al. 1974; Semenov 1964).

The fourth artifact is unique to the entire chipped stone assemblage both temporally and stylistically. It consists of the distal fragment of a formal spurred end scraper of a probable PaleoIndian to Early Archaic affiliation. The implement exhibits severe edge wear, and analysis was not able to determine if the edge damage occurred from previous use or from re-use at the site. The scavenging and re-use of old tools appears to be quite common in the Southwest and is documented from both ethnographic (Fowler and Fowler 1981; Fowler and Matley 1978; Stewart 1942) and archaeological (Moffit and others 1978; Sweeney and Euler 1963) contexts.

Average Measurements:	Length:	Range:	63-45.5 mm
		Mean:	52.8 mm
		Standard Deviation:	7.41
	Width:	Range:	52.5-24.5 mm
		Mean:	39.2 mm
		Standard Deviation:	9.98
	Thickness:	Range:	25-5.5 mm
		Mean:	16.8 mm
		Standard Deviation:	7.09

Raw Material: 3 Quartzite

Artifact 42Ws1630-61: Length: Indeterminate Raw Material: White chert
Width: 24.5 mm
Thickness: 5.5 mm

Wedges/Pieces Esquillees

4 Specimens: Artifacts 42Ws1631-22, 42Ws1632-62, 42Ws1632-75, 42Ws1632-77 (Figure 6.4)

Pairs of opposed striking platforms and evidence of heavy sustained percussion are the dominant characteristics of this artifact class. These tools are functionally referred to as "wedges" but are also known as pieces esquillees which literally translates as "scaled or splintered tools" (Bardon and Bouyssonie 1906:170).

The salient attributes of pieces esquillees, as manifested in the Washington City-Green Spring assemblage, are a roughly square or rectangular shape, biconvex cross-section, one bipolar axis of percussion, and edge damage consisting of heavy concentric rippling and step/hinge terminations. All

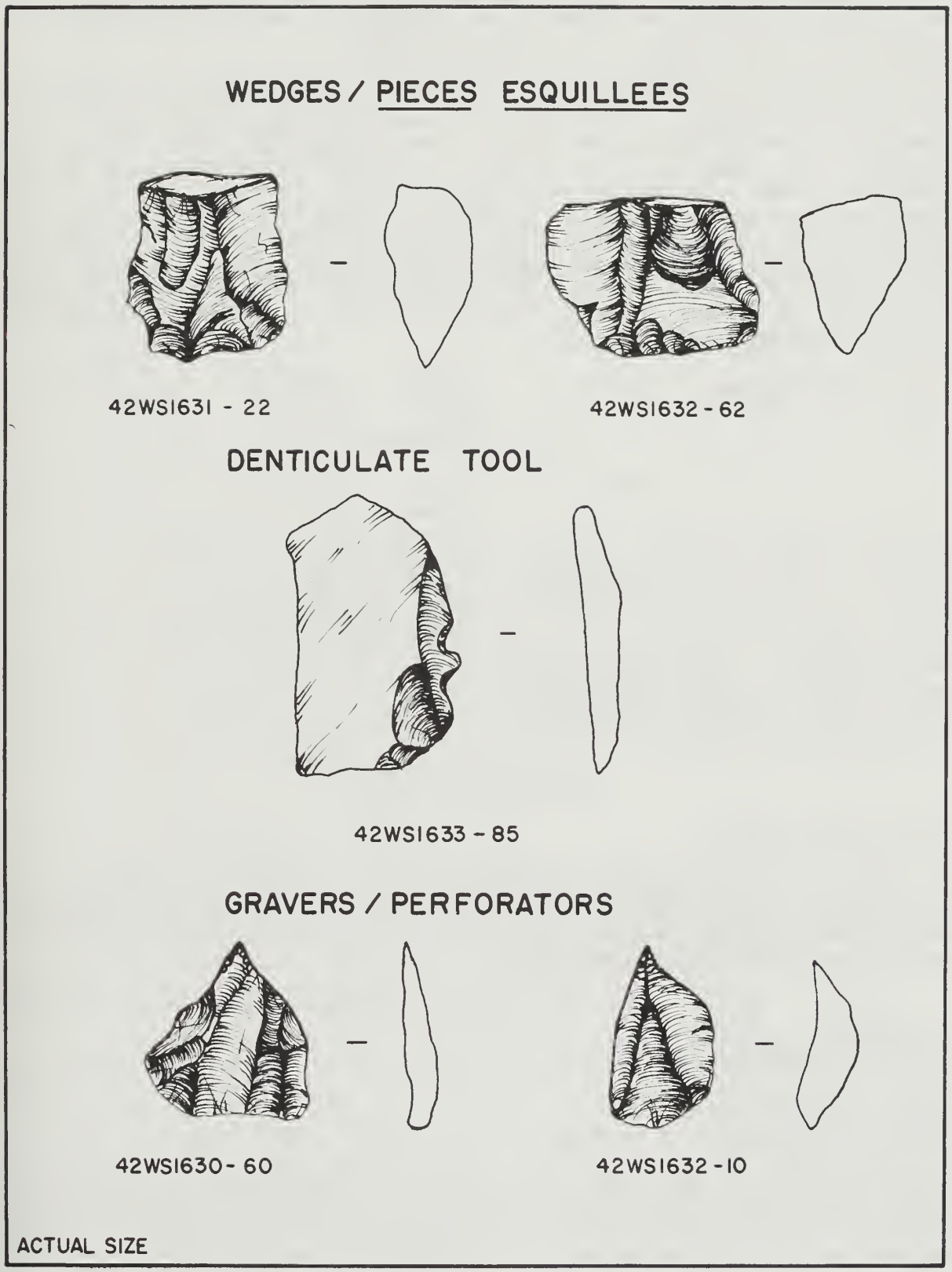


FIGURE 6.4. Wedges/Pieces Esquillees, Denticulate Tool, and Gravers/Perforators.

four specimens were not derived from raw material in cobble or pebble form, but rather from other tool forms. One artifact in particular, 42Ws1632-83, was derived from the broken midsection of a biface.

A variety of hypotheses have been advanced on the function of these artifacts, including utilization as wedges, chisels, percussors for tool manufacture, and bipolar cores (Lothrop and Gramly 1982). The bipolar core inference can reasonably be ruled out because the specimens derive from other tool forms. The use as percussors seems questionable. It is suspected that these implements served as a chisel or wedge for working wood, bone, and/or antler. Informal experiments carried out using either a hammerstone or a soft hammer billet as a percussor have found pieces esquillees to be an efficient means of splitting both wood and bone, particularly by employing the wedges in tandem to split the material (Bruce Huckell, University of Arizona: personal communication).

Average Measurements	Length:	Range:	38-22 mm
		Mean:	32.3 mm
		Standard Deviation:	6.43
	Width:	Range:	26.5-19 mm
		Mean:	22.7 mm
		Standard Deviation:	3.5
	Thickness:	Range:	21-9 mm
		Mean:	14.2 mm
		Standard Deviation:	4.96
Raw Material:	3 Chert		
	1 Jasper		

Retouched Flake Tools

Artifact 42Ws1632-76

This tool is a secondary decortication flake displaying unifacial retouch on the right dorsal lateral margin. Edge wear displays dorsal microflaking and slight rounding/polish. The artifact appears to have functioned as both a cutting and scraping implement.

Length: 40 mm
Width: 30 mm
Thickness: 7.5 mm
Raw Material: Mottled blackish white chalcedony

Artifact 42Ws1633-89

This specimen was manufactured from the midsection of a rather crude biface. One lateral edge displays extensive, well-patterned bifacial pressure retouch while the opposite margin appears to have been purposely blunted, perhaps to facilitate hafting. The transverse cross-section is basically

wedge-shaped and the longitudinal cross-section is biconvex. Edge wear displays slight to moderate rounding and polish with light to moderate bifacial microflaking.

Length: 35.5 mm
Width: 31.5 mm
Thickness: 10.5 mm

Raw Material: Mottled blackish white chalcedony

Artifact 42Ws1632-55

This artifact consists of a natural tabular fragment of chert which has been unifacially flaked on two opposing flake fractures to form 45° and 60° scraping edges, respectively. Edge wear on both bits exhibit slight crushing and attrition.

Length: 33 mm
Width: 25 mm
Thickness: 9 mm

Raw Material: Red chert

Utilized Flakes

14 Specimens

This category consists of lithic flakes or spalls which show signs of having been utilized without intentional retouch along a portion or portions of one or more edges. The edge wear is patterned to some degree, and ranges from light to heavy, but the implement still retains its original flake morphology. Two distinctive groups of unretouched utilized flakes were obvious in the assemblage and were separated accordingly. The first group consists of large coarse-grained quartzite cobble flakes and the second includes relatively smaller fine-grained chert and chalcedony flakes. Both groups show marked differences in flake usage and raw material selectability.

Group I: Utilized Quartzite Cobble Flakes

This group comprises 8 large quartzite cobble flakes, all of a size that could easily be grasped in the palm of the hand. All specimens are hard hammer primary and secondary core reduction flakes which display thick platforms and pronounced bulbs of percussion. Edge utilization occurs on one lateral margin on 3 specimens, distal utilization on 4 specimens, and both lateral and distal utilization on the remaining artifact.

Various researchers have commented on the difficulty of discerning wear damage on quartzite flakes. This observation is especially true where short-term light usage might not produce use-wear detectable at magnification. Such is not the case with the utilized flakes constituting this group. All eight artifacts display edge damage in greater or lesser degrees easily observed without the aid of a microscope. Most of the flakes exhibit blunting of the utilized edge along with smoothing and/or polish. Unifacial micro-scarring/flaking is common and perpendicular or converging striation occurs on several of the well-used specimens. These utilization traces are commonly

related to a scraping function (Ahler 1974:308) and the smoothing and/or polish edge damage is one indication that the tools were used on substances of moderate resistance.

Average Measurements:	Length:	Range:	59-45 mm
		Mean:	51.7 mm
		Standard Deviation:	6.62
	Width:	Range:	77-32 mm
		Mean:	53.9 mm
		Standard Deviation:	13.1
	Thickness:	Range:	28-8 mm
		Mean:	15.4 mm
		Standard Deviation:	5.91

Group II: Utilized Chert/Chalcedony Flakes

Group II consists of 6 small utilized flakes that were probably gripped between the index finger and the thumb. Five of the tools are bifacial thinning flakes; the sixth is a thin primary decortication flake. The worked facets on all of the flakes are the lateral margins. Observed edge damage is moderate, as compared to the heavy use damage noted for Group I. Both bifacial and unifacial microscarring, along with some smoothing and polish on edges, were observed in the collection. Inferred function would suggest that this group of artifacts was used in combinations of both cutting and scraping activities.

Average Measurements:	Length:	Range:	40.5-27 mm
		Mean:	33.6 mm
		Standard Deviation:	4.55
	Width:	Range:	31-16.5 mm
		Mean:	22.6
		Standard Deviation:	5.22
	Thickness:	Range:	8-3.5 mm
		Mean:	5.4 mm
		Standard Deviation:	1.66

Edge-Abraded Flake Tools

Artifact 42Ws1630-17

This artifact exhibits one highly abraded lateral edge occurring on a large thin bifacial reduction flake. The abrasion occurs on the lateral edge of the implement, rather than on surfaces adjacent to the edge perimeter. The abraded edge is evenly rounded and exhibits a high polish on the dorsal edge face while the ventral edge is slightly flat. The edge wear pattern runs parallel to the long axis of the edge, indicating use in a backward-

forward motion. Abrasion has been produced experimentally on edges of silicious stone debitage by Richard Wheeler (1965), who suggests that the wear resulted from the incising, cutting, or sawing of soft fine-grained stone. Another possible function is the use of the tool in a longitudinal action on relatively hard materials such as antler, bone, or dry wood.

Length: 52.5 mm
Width: 28.5 mm
Thickness: 4.5 mm
Raw Material: Gray chert

Artifact 42Ws1632-66

Artifact 42Ws1632-66 consists of the distal fragment of a large secondary core reduction flake. Edge abrasion occurs along one lateral edge beginning at the distal end and extending up the right dorsal lateral margin. The tool appears to have broken during usage as evidenced by the transverse snap fracture.

Length: Indeterminate
Width: Indeterminate
Thickness: 1 mm
Raw Material: Quartz cobble

Denticulate Tool

Artifact 42Ws1633-85 (Figure 6.4)

This artifact consists of a large secondary decortication flake fragment which has been unifacially flaked on one lateral margin to form a convex denticulated scraping edge. The retouch consists of an area 13.5 mm in length forming one robust projection; edge wear exhibits slight crushing, attrition, and unifacial microflaking which is heaviest on the projection. The working edge angle is approximately 40 to 45°.

Length: 46 mm
Width: 27.5 mm
Thickness: 8 mm
Raw Material: Yellowish brown chert

Gravers/Perforators

Artifact 42Ws1632-10 (Figure 6.4)

This tool consists of a hard hammer secondary decortication flake; the worked tip has been fashioned from the natural corner protrusion of the flake. The tip has been slightly modified by deliberate dorsal unifacial retouch along both adjacent margins. Edge wear exhibits rounding and polish of the tip with slight microflaking.

Length: 29.5 mm
Width: 17.5 mm
Thickness: 11 mm
Raw Material: Obsidian

Artifact 42Ws1630-60 (Figure 6.4)

This specimen was manufactured from a relatively thick interior flake. The tip was fashioned by heavy dorsal unifacial retouch and both lateral margins extending from the tip to the bit of the tool exhibit edge utilization. The artifact appears to have functioned both as a perforator and as a scraping/cutting tool as evidenced by the moderate rounding and polish on the tip and ventral microflaking on the bit lateral edges.

Length: 28.5 mm
Width: 30 mm
Thickness: 7.5 mm

Raw Material: Gray chert

Artifact 42Ws1629-104

This artifact is considerably smaller than the other two graver/perforators and appears to have had several different functions. The composite tool is made from a thin interior flake; two opposite lateral ends have been worked into long narrow sharp points and a third end modified into a rather blunt, square protrusion. All margins of the tool have been unifacially flaked around the entire flake perimeter. The two sharp tips display slight polish while margins back from the tips are abraded. The blunt protrusion may have served as the hafting element for the implement.

Length: 18 mm
Width: 14 mm
Thickness: 2.5 mm

Raw Material: Brownish tan chert

Cores

4 Specimens

Following White (1963:5), "the term core refers to a block, or nodule, from which flakes are detached." Furthermore, cores are distinguished from other flaked items since flake production alone appears to have been the primary goal (Geib 1985:347). Two different types of cores were recognized in the collection; multi-directional and patterned. The former consists of amorphous cores which exhibit no patterned or systematic flake removal and lack evidence of any type of core preparation and/or trimming. Unpatterned flaking is generally associated with a more casual approach where flakes are detached from any appropriate platform surface with little concern for core geometry. Two such cores constitute this group. The remaining two specimens are typed as systematic patterned cores because flakes have been removed from prepared platforms in a systematic rather than random fashion. Both of these cores are of a fine jasper material and both were flaked to such an extent that they may be inferred as exhausted.

Measurements: Multi-directional Cores

Artifact 42Ws1630-7:	Length:	75 mm	Raw Material:	Gray chert
	Width:	49 mm		
	Thickness:	37 mm		
Artifact 42Ws1632-68:	Length:	70 mm	Raw Material:	White chert
	Width:	49 mm		
	Thickness:	26 mm		

Measurements: Patterned Cores

Artifact 42Ws1629-112:	Length:	37.5 mm	Raw Material:	Jasper
	Width:	38.5 mm		
	Thickness:	26 mm		
Artifact 42Ws1633-75:	Length:	32 mm	Raw Material:	Jasper
	Width:	34.5 mm		
	Thickness:	30 mm		

Hammerstones/Battered Implements

8 Specimens

The notable attributes of hammerstones/battered implements are the varying degrees of battering and severe attrition present along one or more sinuous edges. These artifacts are presumably used to pound, mash, hammer, or beat other materials. Edge utilization ranges from light pecking (with many incipient cones and ring cracks of varying sizes) to heavy battering, pecking, and spalling which usually terminates in hinge and/or step fractures. These tools are generally palm-sized or smaller and reflect a variety of shapes in longitudinal outline ranging from irregular or subrounded profiles to more ovoid or discoidal shapes. Several of the specimens display pecked and polished facets on both the dorsal and ventral surfaces possibly for the comfort in handling or for a firmer thumb and finger tip grasp. The varying degrees of battering present on the hammerstones suggest a stone on stone contact.

Average Measurements:	Length:	Range:	82-55.5 mm
		Mean:	67.7 mm
		Standard Deviation:	8.7
	Width:	Range:	67.5-36 mm
		Mean:	45.38
		Standard Deviation:	18.89

	Thickness:	Range:	48-15.5 mm
		Mean:	28.6 mm
		Standard Deviation:	9.22

Raw Material: 7 Quartz cobbles
1 Chert

Abraded Cobble Tool

4 Specimens

This category consists of quartz cobbles which display abrasively ground peripheral edges. Similar to hammerstones, abraded cobble tools are generally palm-size or smaller and reflect a variety of shapes in longitudinal outline ranging from irregular or subrounded profiles to more ovoid or discoidal shapes (Davis 1985:153). Several of these specimens initially displayed sharp sinuous edges which were later rounded by abrasion, while others utilized the unmodified natural edge or break of a quartz cobble. The abrasively ground edges are convex and beveled in profile suggesting prolonged usage. The traditional explanation for the gross edge grinding is the result of rubbing pecked stone (especially manos) to smooth and finish them or to just maintain their utility (Dodd 1979:237). Another possible explanation for the edge abrasion is the use of these implements to crack and grind small seeds by friction and pressure. Euler and Dobyns mention a similar usage in their 1983 publication on the ethnoarchaeology of Pai milling stones.

Average Measurements:	Length:	Range:	95-62 mm
		Mean:	73.5 mm
		Standard Deviation:	12.81
	Width:	Range:	57.5-47.5 mm
		Mean:	52.2 mm
		Standard Deviation:	4.13
	Thickness:	Range:	54-27.5 mm
		Mean:	37.1 mm
		Standard Deviation:	10.77

Raw Material: 4 Quartz cobbles

Hammerstone Resharpening Flakes

11 Specimens

This category does not represent a special tool type but rather the by-products resulting from the resharpening of either a hammerstone or abraded cobble tool in order to create a sharp sinuous working edge. All eleven specimens are primary and secondary decortication flakes which display moderate to heavy edge battering, spalling, and abrasion. The use of sharp-edged stones to shape and sharpen ground stone tools has been observed in the

Southwest by Bandelier (1966:156, 1970:46), Gifford (1940), Eddy (1964), Lange (1959:174), and Simpson (1952:185). Dodd's replicative experimentation study with battered implements found that sharp sinuous-edged stone tools were well suited for shaping and maintaining ground stone implements and when blunt, the edges of the tool served a secondary function in pulverizing plant and animal materials on a metate (1979:239). Six of the specimens were recovered from Site 42Ws1632.

Average Measurements:	Length:	Range:	65-30.5 mm
		Mean:	46.8 mm
		Standard Deviation:	10.85
	Width:	Range:	59-17 mm
		Mean:	34.5 mm
		Standard Deviation:	10.44
	Thickness:	Range:	25.5-7 mm
		Mean:	14.1 mm
		Standard Deviation:	5.85

Grooved Abrader

Artifact 42Ws1632-88

This artifact consists of a small hand-held rectangular sandstone slab. The bottom surface is relatively flat and the lateral edges have been beveled by bifacial grinding, possibly for ease in handling. The artifact displays a single groove which runs parallel to the long axis of the implement. The groove is 68 mm long, 4 mm wide, 3 mm deep and was worn by a reciprocal use-abrasion.

Length:	72 mm
Width:	44.5 mm
Thickness:	13 mm

Milling Stones

A total of 18 pieces of milling implements was recovered from four of the six rockshelters (42Ws1629, 1630, 1632, and 1633). Two miscellaneous unifacially ground pieces of sandstone and quartzite, respectively, also were collected from 42Ws1629. These are only mentioned here, since they lack sufficient attributes for classification. Due to the low number and fragmentary condition of these artifacts, insufficient attributes were present to permit classification into specific artifact types. Hence, two general artifact classes are recognized: manos and grinding slabs. Variation in artifact class, raw material composition, and frequency of occurrence are used to evaluate resource processing emphases and rockshelter function.

Milling Stones in Archaeological and Ethnographic Contexts

As used here, the term mano refers to a stone held in the hand and used in conjunction with a stone slab for grinding, pulverizing, and/or crushing soft materials. This artifact class includes such tools variously called one-hand manos, two-hand manos, handstones, oval cobble manos, mullers, and the like (Woodbury 1954; Haury 1950; Euler and Dobyns 1983). Grinding slabs are generally differentiated from metates on the basis of form and function. Grinding slabs are usually flat, tabular pieces of sandstone or igneous rock that lack formal shaping. The grinding facet is generally produced by different kinds of use-wear. A rotary motion results in a basin-shaped concavity, while reciprocal grinding or crushing technique produces an elongated flat-to-troughed concavity. Metates exhibit shaping of the exterior surfaces by flaking, pecking, and/or abrasion, and additional modification to form a troughed grinding surface. Grinding slabs were used for a greater variety of reduction tasks, such as pulverizing plant fibers, cracking/crushing seeds, tenderizing dried meat, crushing pottery temper, reducing paint pigments, and so on. The type of use can be evaluated by consideration of the raw material composition of the slab (e.g., fine-grained vs. coarse-grained) and the type of mano or other tool used as a percussor or abrader. Metates similarily could have been used for such tasks, although they are more commonly associated with corn-grinding.

Typically, one-hand manos and handstones are associated with grinding slabs in prehistoric seed-grinding economies, while two-hand manos are generally associated with troughed metates or mealing bins in horticultural economies for grinding corn (cf. Sayles and Antevs 1941; Haury 1951; Martin and Plog 1973). Previous research at prehistoric Virgin Anasazi sites has shown greater formal variation among mano types, where two-hand manos and handstones (or one-hand manos) exhibit formal, mutually exclusive attributes (Dalley and McFadden 1985; Metcalf 1978; Nickens and Kvamme 1981). At the Red Cliffs Site, a Pueblo I-early Pueblo II habitation (Dalley and McFadden 1985), two-hand manos were dominant, implying an emphasis on corn-grinding. On the other hand, at several Virgin Anasazi/Southern Paiute camp sites in the Beaver Dam Mountains, oval one-hand manos of fine-grained sandstone were the most common type. These were associated with a relatively high frequency of grinding slabs, implying an emphasis on seed-grinding (Metcalf 1978:142-145). Lastly, at the Kanab Site, a multicomponent Basketmaker II/Pueblo II pit house site, two-hand manos and handstones (one-hand manos) were equally represented, in association with a low number of formal trough metates and a high frequency of grinding slabs (Nickens and Kvamme 1981:52). The botanical data from the Kanab Site indicated a mixed reliance on horticulture and wild plant gathering, thus complementing the milling tool assemblage.

The Southern Paiute, with their eclectic, mixed subsistence base and the need for easily portable milling equipment, may have placed less emphasis on formal grinding tool kits. Recently, Euler and Dobyns (1983) have documented Pai use of a single mano used in conjunction with grinding slabs of various forms for a variety of tasks that included two-hand grinding, pounding, cracking, crushing, and pulverizing. Such a mano, on the basis of size, would be classed as a one-hand mano, although two hands were necessary to

achieve desired results. Hence, among groups such as the Pai, who incorporated horticulture, hunting, and gathering into their subsistence base, a single artifact class was used for a variety of reduction tasks. Moreover, Euler (Euler and Dobyns 1983:264) has noted that milling equipment on Southern Paiute sites in the Virgin River drainage is identical to that observed in Pai milling stone assemblages.

Hence, the existing archaeological and ethnoarchaeological data base indicates that at least two different grinding tool kits are likely to be represented at the Washington City-Green Spring rockshelters. Although formal metates were not identified in the present collection, the fragmentary nature of the artifacts and the inaccessibility of material culture remains in the two collapsed rockshelters (42Ws1631 and 42Ws1632) must be recognized as limiting factors on the data base. The possibility still exists that formal metates are represented and this will be assessed after a consideration of the mano analysis results in conjunction with the botanical data.

Site 42Ws1629

Artifact 42Ws1629-58

The artifact is an end fragment of a probable subrectangular mano with a wedge-shaped lateral cross-section. It was made from a natural cobble, unmodified except for abrasion on the use surface. The use surface exhibits no pecking scars, and has been ground smooth. Use-wear extends slightly over the end, indicating use on a concave (basin or trough) grinding surface. The end displays moderate battering.

Length:	57 mm*	Raw Material:	Vesicular basalt
Width:	80 mm		
Thickness:	46 mm		

Artifact No: 42Ws1629-60

The artifact is a side/end fragment of mano. The side has been pecked and flaked to shape. The single use surface exhibits pecking scars in center, and is ground smooth to a convex surface. Use-wear extends slightly over the side, indicating use on a concave (basin) grinding surface; the opposite surface is unmodified.

Length:	87 mm*	Raw Material:	Fine-grained orange-tan
Width:	57 mm*		sandstone
Thickness:	20 mm		

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* An asterisk indicates incomplete measurement due to artifact breakage.

Artifact 42Ws1629-61a

The artifact is a side fragment of a probable one-hand cobble mano. The side is heavily pecked to a convex shape, and exhibits moderate to heavy abrasion. The use surface has been heavily ground to a smooth, nearly flat surface. Use-wear does not extend over the side of the mano, indicating use on a flat grinding surface.

Length: 47 mm*
Width: 39 mm*
Thickness: 22 mm*

Raw Material: Fine-grained pink-tan-gray quartzite

Artifact No: 42Ws1629-61b

The artifact is a horizontal spall of a possible grinding slab displaying one well-ground use surface. The use-surface exhibits light, random pecking, and is heavily ground to a smooth, flat surface. The opposite surface is the rough interior of a spall from the parent rock. The sides and base are absent.

Length: 100 mm*
Width: 58 mm*
Thickness: 12 mm*

Raw Material: Fine-grained reddish tan sandstone

Artifact No: 42Ws1629-62b

The artifact is a section of a probable subrectangular to ovoid grinding slab. The sides are roughly pecked to shape. The use surface exhibits moderate pecking to roughen and is ground smooth to a shallow concavity 10 mm deep. The wear pattern indicates a rotary grinding pattern.

Length: 147 mm*
Width: 120 mm*
Thickness: 34 mm

Raw Material: Fine-grained, pinkish-tan sandstone

Site 42Ws1630

Artifact 42Ws1630-41

The artifact is an end piece of a probable subrectangular mano. The sides and end have been roughly pecked to shape. The use surface is heavily scarred from pecking to roughen and is ground smooth. Use-wear does not continue over end, but the end displays light abrasion and minor crushing, implying secondary use for pounding/crushing. The opposite surface is unmodified.

Length: 60 mm*
Width: 80 mm
Thickness: 22 mm

Raw Material: Medium-grained gray sandstone

Site 42Ws1631

Site 42Ws1631 is a collapsed rockshelter. Only a small area in the front (south) could be investigated. No milling stones were found.

Site 42Ws1632

Artifact 42Ws1632-42d

The artifact is a nearly complete, sub-square cobble mano with one corner missing. The natural sub-square shape was only slightly modified by pecking along one side. The artifact is plano-convex in cross-section. The primary use surface exhibits a few shallow pecking scars and is ground smooth. Use-wear extends slightly over the edges, indicating usage on a slightly concave grinding surface. The opposite surface is lightly pecked across the entire surface, but exhibits no abrasion.

Length:	97 mm	Raw Material:	Fine-grained, soft, orange sandstone
Width:	92 mm		
Thickness:	31 mm		

Artifact 42Ws1632-42e

The artifact is a corner piece of a probable unifacial subrectangular mano. The use surface is ground very smooth and flat and the opposite surface is unmodified.

Length:	45 mm*	Raw Material:	Basalt (non-vesicular)
Width:	36 mm*		
Thickness:	30 mm		

Artifact 42Ws1632-43

The artifact is a side and end piece of a probable subrectangular mano. The fragment exhibits pronounced shaping by pecking and abrasion. Two use surfaces are present, both of which exhibit pecking scars to roughen, and are ground very smooth. Use-wear extends slightly over both sides, indicating slight rocking during reciprocal grinding on the grinding surface. The end is too fragmentary to determine type of grinding surface.

Length:	72 mm*	Raw Material:	Fine-grained gray quartzite
Width:	40 mm*		
Thickness:	48 mm		

Artifact 42Ws1632-44

The artifact is a wedge-shaped fragment of a probable ovoid cobble mano with one use surface. The cobble had been pecked and abraded to shape around the side. The use surface exhibits large pecking scars near the edge; surface is ground smooth and convex. Use-wear extends slightly over the side; there is a pronounced angle at the junction of use surface with the side, indicating usage on a well-formed, concave grinding surface (e.g., basin). The opposite surface is unmodified. Light battering is evident on the side, indicating secondary use as a pounding implement.

Length: 65 mm*
Width: 52 mm*
Thickness: 50 mm

Raw Material: Fine-grained, soft, orange-tan sandstone

Artifacts 42Ws1632-46 and 42Ws1632-47

Two fragments of a single mano were recovered from two respective levels. The two pieces articulate to form approximately 2/3 of a complete cobble mano. The mano is a well-formed, subrectangular cobble shaped by pecking around the sides and end. Two use surfaces are present. One use surface had been heavily ground to a smooth finish, with edge-wear trailing slightly over both sides. Heavier wear is evident towards one side, indicating heavier forward pressure during reciprocal grinding. The opposite surface is very heavily pecked to roughen and exhibits only light abrasion. Use-wear does not extend over the end, indicating use on a flat or shallow troughed grinding surface. The ends and side display moderate battering.

Length: 105 mm*
Width: 94 mm*
Thickness: 55 mm

Raw Material: Vesicular basalt

Artifact 42Ws1632-42a

This artifact consists of one side and end of a probable flat grinding slab with one use surface. The sides have not been modified. The use surface exhibits only light abrasion toward the center of the grinding facet. The opposite surface is unmodified.

Length: 90 mm*
Width: 81 mm*
Thickness: 26 mm

Raw Material: Fine-grained gray-tan sandstone

Artifact 42Ws1632-42b

This is an interior fragment of a grinding slab. The single use surface has been heavily pecked and ground smooth to very slight concavity. The opposite surface is unmodified.

Length:	140 mm*	Raw Material:	Fine-grained, soft, orange
Width:	72 mm*		sandstone
Thickness:	37 mm		

Artifact 42Ws1632-42c

The artifact is an edge piece of a grinding slab exhibiting one grinding surface. The use surface exhibits moderate pecking to roughen, and is ground smooth and flat. The edge and the opposite surface are unmodified.

Length:	80 mm*	Raw Material:	Fine-grained, soft, orange
Width:	64 mm*		sandstone
Thickness:	25 mm		

Artifact 42Ws1632-45

This is an interior fragment of a grinding slab, lacking sides or ends. The primary use surface has been ground smooth and concave. The opposite surface is flat to slightly concave in profile and also has been ground smooth.

Length:	92 mm*	Raw Material:	Vesicular basalt
Width:	73 mm*		
Thickness:	31 mm		

Site 42Ws1633

Artifact 42Ws1633-17a

This artifact consists of two fragments of a grinding slab which articulate to form one piece. The artifact is a side piece with an irregular outline, partially flaked to shape. The use surface exhibits only light pecking to roughen and has been ground smooth. Only light usage is evident. The opposite surface is unmodified.

Length:	136 mm*	Raw Material:	Fine-grained gray-tan
Width:	127 mm*		sandstone
Thickness:	23 mm		

Artifact 42Ws1633-17b

The artifact is a side fragment of a thin grinding slab with one use surface. The side and opposite surface are unmodified. The use surface exhibits only very light pecking to roughen and is ground very smooth to a shallow concavity.

Length:	123 mm*	Raw Material:	Fine-grained, gray-tan
Width:	101 mm*		sandstone
Thickness:	18 mm		

Artifact 42Ws1633-18

The artifact consists of two pieces of a grinding slab which do not articulate, but which exhibit identical attributes indicating derivation from the same parent artifact. The artifact is an irregular piece with unmodified sides and one use surface. The use surface exhibits no pecking to roughen and only light abrasion is evident. The opposite surface is unmodified.

Dimensions:	Piece A	Piece B
Length:	116 mm*	75 mm*
Width:	70 mm*	55 mm
Thickness:	33 mm	23 mm

Raw Material: Fine-grained, soft, orange sandstone

Comment: The relatively soft raw material and absence of pecking scars on the use surface suggests that the implement was used for fine abrading rather than milling coarse substances.

42Ws1634

No milling stones were recovered from this site.

Debitage

The term debitage is defined here as the waste material from the manufacture and maintenance of stone tools. A total of 348 pieces of debitage was collected from the seven Washington City-Green Spring sites. The collection was separated by individual sites and analyzed according to the following categories of attributes: flake type, platform thickness, size, material composition, and heat alteration. The categories of flake types are defined as follows:

1. Primary Decortication Flake. A primary flake or spall, usually thick, with dorsal face being entirely cortex; striking platform usually at a right angle to flake axis. This type of flake corresponds to Crabtree's (1972) hard hammer flake and exhibits a large bulb of percussion, strong force rings and fissures, and may sometimes display cracked or crushed striking platforms. Primary decortication flakes are interpreted as the initial stage of core reduction.

2. Primary Decortication Flake Fragment.

3. Secondary Decortication Flake. A flake with dorsal face exhibiting minimal cortex with one or more negative flake scars that resulted from primary reduction of a core.

4. Secondary Decortication Flake Fragment.

5. Interior Flake with Cortex. Flake with minimal cortex present on the platform. This flake type usually represents the latter stages of primary reduction.

6. Interior Flake with Cortex Fragment.

7. Interior Flake. A flake that displays surfaces free of cortex. This type of flake corresponds to Crabtree's (1972) soft hammer flake and is most often interpreted as being struck from the edges of a bifacial blank/core. Soft hammer percussion exhibits thinner platforms than hard hammer percussion, diffuse bulbs of percussion, and lipping (platform overhang on the interior flake surface). It is assumed that these flakes represent later stages of manufacture and/or by-products of tool maintenance and modification.

8. Interior Flake Fragments.

9. Primary Shatter. Irregularly shaped, broken or fractured waste flakes displaying cortex and lacking a bulb of percussion, platform, distal flake end or other attributes characteristic of sequential reduction flakes.

10. Secondary Shatter. Irregularly shaped, broken or fractured waste flakes lacking cortex, a bulb of percussion, platform, distal flake end, or other attributes characteristic of sequential reduction flakes.

The second variable, "platform thickness," constitutes the measurable size/thickness of the platform. It is assumed that different platform size indices may reflect different flaking techniques. Bordes (1972:81) and Rozen (1979:163) have observed a major difference in platform thickness between hard hammer and soft hammer percussion; the former produces a larger and thicker platform.

The third variable is the size of complete flakes and is indexed according to length and width. The length of a complete flake constitutes the distance between the point of impact/striking platform and the distal end of the flake. The width was taken from the largest distance between lateral edges as measured perpendicular to the longitudinal axis of the flake.

The fourth variable consists of the raw material type; the type of raw material was recorded for every artifact. The tabulations of the first four variables are presented in Tables 6.1 through 6.7.

The fifth variable consists of the presence or absence of heat alteration on silica debitage, such as chert and jasper flakes. Thermal pretreatment of silica materials serves a definite purpose in that it causes the material to become less brittle, more elastic, and allows much greater flaking ease in handling the material. Experimental work (Crabtree and Butler 1964; Purdy and Brooks 1971) has shown that fibered and coarse microgranular silica minerals used by prehistoric people are extremely difficult to bifacially reduce in their native state, but after heat alteration the same material can be handled with comparative ease.

TABLE 6.1. Lithic Debitage from 42Ws1629.

TOTAL DEBITAGE = 100	Jasper	Grayish White Chert	Obsidian	Quartzite	Brownish Black Chert	Reddish White Chert	Chalcedony	TOTAL	%
Primary Decortication Flakes (N)			2						
I. Platform Thickness									
Mean			3.5mm						
Range			4-3mm						
II. Size-Length									
Mean			20.5mm						4%
Range			22-19mm						
III. Size-Width									
Mean			16.5mm						
Range			18-15mm						
Primary Decortication Flake Fragments (N)			1				1	2	
Secondary Decortication Flakes (N)				3				3	
I. Platform Thickness									
Mean				9.1mm					
Range				12.5-4mm					
II. Size-Length									4%
Mean				60.3mm					
Range				74.5-48.5mm					
III. Size-Width									
Mean				37.8mm					
Range				60.5-25.5mm					
Secondary Decortication Flake Fragments (N)	1							1	
Interior Flakes with Cortex (N)	1	2	3	2				8	
I. Platform Thickness	8mm								
Mean		2.7mm	3.5mm	14.7mm					
Range		3-2.5mm	5-2mm	22-7.5mm					
II. Size-Length	25mm								10%
Mean		25.5mm	24mm	64mm					
Range		17-34mm	30.5-12mm	68-60mm					
III. Size-Width	10.5mm								
Mean		12mm	15.1mm	48.5mm					
Range		12.5-11.5mm	24.5-12.5mm	52-45mm					
Interior Flake with Cortex Fragments (N)		1			1			2	
Interior Flakes (N)	3	5	8	1	2		3	22	
I. Platform Thickness									
Mean	2.3mm	1.5mm	1.8mm	7.5mm	1.5mm		2.5		
Range	4-1mm	2-1mm	2.5-1mm		2-1mm		3-1.5mm		
II. Size-Length									
Mean	15mm	16.6mm	16.5mm	53.5mm	13mm		17.8mm		
Range	12.5-8.5mm	24.5-9.5mm	27.5-10mm		18-8mm		18.5-13mm		59%
III. Size-Width									
Mean	11mm	13.7mm	11.6mm	35.5mm	10.2mm		13.3mm		
Range	17-6mm	24-7mm	14.5-8mm		12.5-8mm		16-14mm		
Interior Flake Fragments (N)	3	11	12	2	3	2	4	37	
Primary Shatter (N)	2	1		4	1	1	2	11	23%
Secondary Shatter (N)	3	2	2	2	4		1	12	
TOTAL	13	22	28	16	7	3	11	100	

TABLE 6.2. Lithic Debitage from 42Ws1630.

TOTAL DEBITAGE = 34	Jasper	Grayish White Chert	Obsidian	Quartzite	Brownish Black Chert	Reddish White Chert	Chal-cedony	TOTAL	%
Primary Decortication Flakes (N)									
I. Platform Thickness									
Mean									
Range									
II. Size-Length									
Mean									
Range									
III. Size-Width									
Mean									
Range									
Primary Decortication Flake Fragments (N)									
Secondary Decortication Flakes (N)									
I. Platform Thickness									
Mean									
Range									
II. Size-Length									3%
Mean									
Range									
III. Size-Width									
Mean									
Range									
Secondary Decortication Flake Fragments (N)			1					1	
Interior Flakes with Cortex (N)		1		2	1			4	
I. Platform Thickness		3.5mm			1.5mm				
Mean				6.5mm					
Range				9-4mm					
II. Size-Length		17.5mm			12.5mm				26%
Mean					47.5mm				
Range				70-25mm					
III. Size-Width		11.5mm			9.5mm				
Mean				37mm					
Range				59-15mm					
Interior Flake with Cortex Fragments (N)		1	1	2		1		5	
Interior Flakes (N)		1	1					2	
I. Platform Thickness		3.5mm	2.5mm						
Mean									
Range									
II. Size-Length		42mm	25mm						56%
Mean									
Range									
III. Size-Width		31mm	12mm						
Mean									
Range									
Interior Flake Fragments (N)	2	5	3			1	6	17	
Primary Shatter (N)									15%
Secondary Shatter (N)		2		2			1	5	
TOTAL	2	10	6	6	1	2	7	34	

TABLE 6.3. Lithic Debitage from 42Ws1631.

TOTAL DEBITAGE = 14	Jasper	Grayish White Chert	Obsidian	Quartzite	Brownish Black Chert	Reddish White Chert	Chalcedony	TOTAL	%
Primary Decortication Flakes (N)									
I. Platform Thickness									
Mean									
Range									
II. Size-Length									
Mean									
Range									
III. Size-Width									
Mean									
Range									
Primary Decortication Flake Fragments (N)									
Secondary Decortication Flakes (N)									
I. Platform Thickness									
Mean									
Range									
II. Size-Length									
Mean									14%
Range									
III. Size-Width									
Mean									
Range									
Secondary Decortication Flake Fragments (N)				1	1			2	
Interior Flakes with Cortex (N)					1			1	
I. Platform Thickness					7mm				
Mean									
Range									
II. Size-Length					34mm				7%
Mean									
Range									
III. Size-Width					28mm				
Mean									
Range									
Interior Flake with Cortex Fragments (N)									
Interior Flakes (N)	1		2					3	
I. Platform Thickness	2.5mm								
Mean			2.5mm						
Range			3-2mm						
II. Size-Length	15.5mm								
Mean			23.5mm						79%
Range			31-16mm						
III. Size-Width	12mm								
Mean			8mm						
Range			8.5-7.5mm						
Interior Flake Fragments (N)	2	1	4				1	8	
Primary Shatter (N)									
Secondary Shatter (N)									
TOTAL	3	1	6	1	2		1	14	

TABLE 6.4. Lithic Debitage from 42Wsl632.

TOTAL DEBITAGE = 136	Jasper	Grayish White Chert	Obsidian	Quartzite	Brownish Black Chert	Reddish White Chert	Chal-cedony	TOTAL	%
Primary Decortication Flakes (N)			1	1				2	
I. Platform Thickness			4.5mm	5.5mm					
Mean									
Range									
II. Size-Length			22.5mm	32mm					3%
Mean									
Range									
III. Size-Width			18mm	27mm					
Mean									
Range									
Primary Decortication Flake Fragments (N)		1				1		2	
Secondary Decortication Flakes (N)		3	1	4	1			9	
I. Platform Thickness			3.5mm		3.5mm				
Mean		5.6mm		11mm					
Range		7-4mm		14.5-7.5mm					
II. Size-Length			29mm		26.5mm				15.5%
Mean		38.5mm		53.7mm					
Range		58-26.5mm	10mm	70-35mm					
III. Size-Width					17.5mm				
Mean		28mm		35.3mm					
Range		38-18mm		45-28mm					
Secondary Decortication Flake Fragments (N)	5		2	5				12	
Interior Flakes with Cortex (N)	1	4	1		1	1	1	9	
I. Platform Thickness	4mm		4mm		4.5mm	4.5mm	4.5mm		
Mean		4.1mm							
Range		4.5-4mm							
II. Size-Length	26mm		24mm		29mm	34.5mm	23mm		15.5%
Mean		29.5mm							
Range		33-27mm							
III. Size-Width	15.5mm		21mm		22mm	25.5mm	16mm		
Mean		18.6mm							
Range		21.5-14mm							
Interior Flake with Cortex Fragments (N)	2	2	3	4	1			12	
Interior Flakes (N)	4	5	6		1			16	
I. Platform Thickness					2mm				
Mean	2.5mm	2.1mm	2mm						
Range	3.5-2mm	3-1.5mm	2.5-1.5mm						
II. Size-Length					15.5mm				44%
Mean	16.3mm	19.9mm	15.5mm						
Range	24-13mm	23-15.5mm	25-12mm						
III. Size-Width					12mm				
Mean	12mm	13.3mm	9.3mm						
Range	16.5-9mm	16.5-9mm	13.5-6mm						
Interior Flake Fragments (N)	5	12	21	1	2		3	44	
Primary Shatter (N)	4	4	1			1		10	22%
Secondary Shatter (N)	3	6	4	5			2	20	
TOTAL	24	37	40	20	6	3	6	136	

TABLE 6.5. Lithic Debitage from 42Ws1633.

TOTAL DEBITAGE = 19	Jasper	Grayish White Chert	Obsidian	Quartzite	Brownish Black Chert	Reddish White Chert	Chal-cedony	TOTAL	%
Primary Decortication Flakes (N)									
I. Platform Thickness									
Mean									
Range									
II. Size-Length									
Mean									
Range									
III. Size-Width									
Mean									
Range									
Primary Decortication Flake Fragments (N)									
Secondary Decortication Flakes (N)			1	1	1			3	
I. Platform Thickness			3mm	9mm	4mm				
Mean									
Range									
II. Size-Length			31mm	42mm	24mm				21%
Mean									
Range									
III. Size-Width			16.5mm	27mm	17mm				
Mean									
Range									
Secondary Decortication Flake Fragments (N)				1				1	
Interior Flakes with Cortex (N)			2	1				3	
I. Platform Thickness				6.5mm					
Mean			5.2mm						
Range			6-4.5mm						
II. Size-Length				39.5mm					16%
Mean			34.5mm						
Range			41-28mm						
III. Size-Width				30mm					
Mean			23.2mm						
Range			29.5-17mm						
Interior Flake with Cortex Fragments (N)									
Interior Flakes (N)		1	2		1		1	5	
I. Platform Thickness		2.5mm			4.5mm		3mm		
Mean			3mm						
Range			3mm						
II. Size-Length		23mm			23mm		40.5mm		37%
Mean			25.2mm						
Range			37.5-15mm						
III. Size-Width		12.5mm			21mm		27.5mm		
Mean			15.7mm						
Range			20-11.5mm						
Interior Flake Fragments (N)			2					2	
Primary Shatter (N)	1							1	26%
Secondary Shatter (N)	2		1	1				4	
TOTAL	3	1	8	4	2		1	19	

TABLE 6.6. Lithic Debitage from 42Wsl634.

TOTAL DEBITAGE = 4	Jasper	Grayish White Chert	Obsidian	Quartzite	Brownish Black Chert	Reddish White Chert	Chal-cedony	TOTAL
Primary Decortication Flakes (N)								
I. Platform Thickness								
Mean								
Range								
II. Size-Length								
Mean								
Range								
III. Size-Width								
Mean								
Range								
Primary Decortication Flake Fragments (N)								
Secondary Decortication Flakes (N)				1				1
I. Platform Thickness				12.5mm				
Mean								
Range								
II. Size-Length				37mm				
Mean								
Range								
III. Size-Width				28.5mm				
Mean								
Range								
Secondary Decortication Flake Fragments (N)								
Interior Flakes with Cortex (N)								
I. Platform Thickness								
Mean								
Range								
II. Size-Length								
Mean								
Range								
III. Size-Width								
Mean								
Range								
Interior Flake with Cortex Fragments (N)								
Interior Flakes (N)		1						1
I. Platform Thickness		2.5mm						
Mean								
Range								
II. Size-Length		28mm						
Mean								
Range								
III. Size-Width		21mm						
Mean								
Range								
Interior Flake Fragments (N)		2						2
Primary Shatter (N)								
Secondary Shatter (N)								
TOTAL		3		1				4

TABLE 6.7. Lithic Debitage from 42Ws1828.

TOTAL DEBITAGE = 41	Jasper	Grayish White Chert	Obsidian	Quartzite	Brownish Black Chert	Reddish White Chert	Chalcedony	Basalt	TOTAL	%
Primary Decortication Flakes (N)				1					1	
I. Platform Thickness				10mm						
Mean										
Range										
II. Size-Length				31mm						5%
Mean										
Range										
III. Size-Width				29.5mm						
Mean										
Range										
Primary Decortication Flake Fragments (N)	1								1	
Secondary Decortication Flakes (N)										
I. Platform Thickness										
Mean										
Range										
II. Size-Length										2%
Mean										
Range										
III. Size-Width										
Mean										
Range										
Secondary Decortication Flake Fragments (N)				1					1	
Interior Flakes with Cortex (N)				1		1			2	
I. Platform Thickness				7.5mm		5.5mm				
Mean										
Range										
II. Size-Length				36mm		29mm				8%
Mean										
Range										
III. Size-Width				23mm		19.5mm				
Mean										
Range										
Interior Flake with Cortex Fragments (N)				1					1	
Interior Flakes (N)	2	2			1		3		8	
I. Platform Thickness					2mm					
Mean	3.7mm	.8mm					2.8mm			
Range	4-3.5mm	1.5-1mm					5-1.2mm			
II. Size-Length					22mm					73%
Mean	18.5mm	22.5mm					19.6mm			
Range	20-17mm	24-21mm					23.5-13.5mm			
III. Size-Width					15mm					
Mean	10mm	12mm					11mm			
Range	13-7mm	16-8mm					16-7mm			
Interior Flake Fragments (N)	1	15	1	1	2		2		22	
Primary Shatter (N)				1					1	12%
Secondary Shatter (N)				2			1	1	4	
TOTAL	4	17	1	8	3	1	6	1	41	

The aboriginal technique of thermal pretreatment appears to have been to place the silica material in the ground beneath a fire allowing heat to be more slowly and evenly distributed throughout the material (Anderson 1971; Gilman 1971). When subjected to rapid temperature change, such as intrusion into an open fire, silica material has the tendency to crack and spall (Crabtree and Butler 1964).

It has been Crabtree's experience that heat treatment is more likely to be successful with a thin piece of chert than with a whole core, since even heat distribution is more easily achieved (1966). Cores can be treated but must be heated more slowly and for a longer period of time (Ibid. 1966:17). Crabtee believes that the usual aboriginal practice was to strike off large flakes or blanks or to rough out preforms at a quarry site and carry these back to a campsite for firing before finishing the tool (1966:17).

The hallmark in recognizing heat-treated silica material is a greasy, glossy, or vitreous luster apparent on a negative flake scar. Except for a possible change in color, a heat-treated flake or blank looks exactly like an untreated one. Only flakes removed after heating leave lustrous scars. For this reason the identification of heat alteration was based on luster variations occurring between individual flake scars on any one piece.

Tables 6.8 through 6.14 denote the number and overall percentage of heat treated silica debitage pieces for each site. In calculating the overall percentage of heat treated pieces in relationship to the total debitage assemblage from each site, only silica debitage was counted since obsidian and quartzite are not amenable to heat alteration.

TABLE 6.8. Heat Alteration of Lithic Debitage at Site 42Ws1629.

	Jasper	Grayish White Chert	Brownish Black Chert	Reddish White Chert	Chalcedony
Primary Decortication Flake:					
Primary Decorticcation Flake Fragment:					
Secondary Decortication Flake:					
Secondary Decortication Flake Fragment:	1				
Interior Flake with Cortex:	1	1			
Interior Flake with Cortex Fragment:			1		
Interior Flake:	4	1			1
Interior Flake Fragment:	2	4	1		1
Primary Shatter:	2	1			1
Secondary Shatter:	2				

Total Number of Silica Debitage Pieces:	43
Number of Heat Alteration Debitage Pieces:	24
Percentage of Heat Alteration Debitage Pieces:	43%

TABLE 6.9. Heat Alteration of Lithic Debitage at Site 42Ws1630.

	Jasper	Grayish White Chert	Brownish Black Chert	Reddish White Chert	Chalcedony
Primary Decortication Flake:					
Primary Decorticcation Flake Fragment:					
Secondary Decortication Flake:					
Secondary Decortication Flake Fragment:					
Interior Flake with Cortex:					
Interior Flake with Cortex Fragment:					
Interior Flake:					
Interior Flake Fragment:	1				
Primary Shatter:					
Secondary Shatter:					

Total Number of Silica Debitage Pieces:	22
Number of Heat Alteration Debitage Pieces:	1
Percentage of Heat Alteration Debitage Pieces:	4.5%

TABLE 6.10. Heat Alteration of Lithic Debitage at Site 42Ws1631.

	Jasper	Grayish White Chert	Brownish Black Chert	Reddish White Chert	Chalcedony
Primary Decortication Flake:					
Primary Decorticcation Flake Fragment:					
Secondary Decortication Flake:					
Secondary Decortication Flake Fragment:					
Interior Flake with Cortex:					
Interior Flake with Cortex Fragment:					
Interior Flake:					
Interior Flake Fragment:	1	1			
Primary Shatter:		2			
Secondary Shatter:					

Total Number of Silica Debitage Pieces:	7
Number of Heat Alteration Debitage Pieces:	4
Percentage of Heat Alteration Debitage Pieces:	57%

TABLE 6.11. Heat Alteration of Lithic Debitage at Site 42Ws1632.

	Jasper	Grayish White Chert	Brownish Black Chert	Reddish White Chert	Chalcedony
Primary Decortication Flake:					
Primary Decorticcation Flake Fragment:					
Secondary Decortication Flake:					
Secondary Decortication Flake Fragment:	5				
Interior Flake with Cortex:	1				
Interior Flake with Cortex Fragment:	1	1			
Interior Flake:	4				
Interior Flake Fragment:	3				
Primary Shatter:	3			1	
Secondary Shatter:					

Total Number of Silica Debitage Pieces:	76
Number of Heat Alteration Debitage Pieces:	19
Percentage of Heat Alteration Debitage Pieces:	25%

TABLE 6.12. Heat Alteration of Lithic Debitage at Site 42Ws1633.

	Jasper	Grayish White Chert	Brownish Black Chert	Reddish White Chert	Chalcedony
Primary Decortication Flake:					
Primary Decorticcation Flake Fragment:					
Secondary Decortication Flake:					
Secondary Decortication Flake Fragment:					
Interior Flake with Cortex:					
Interior Flake with Cortex Fragment:					
Interior Flake:					
Interior Flake Fragment:					
Primary Shatter:	1				
Secondary Shatter:	2				

Total Number of Silica Debitage Pieces:	10
Number of Heat Alteration Debitage Pieces:	3
Percentage of Heat Alteration Debitage Pieces:	33%

TABLE 6.13. Heat Alteration of Lithic Debitage at Site 42Ws1634.

	Jasper	Grayish White Chert	Brownish Black Chert	Reddish White Chert	Chalcedony
Primary Decortication Flake:					
Primary Decorticcation Flake Fragment:					
Secondary Decortication Flake:					
Secondary Decortication Flake Fragment:					
Interior Flake with Cortex:					
Interior Flake with Cortex Fragment:					
Interior Flake:		1			
Interior Flake Fragment:		1			
Primary Shatter:					
Secondary Shatter:					

Total Number of Silica Debitage Pieces:	3
Number of Heat Alteration Debitage Pieces:	2
Percentage of Heat Alteration Debitage Pieces:	67%

TABLE 6.14. Heat Alteration of Lithic Debitage at Site 42Ws1828.

	Jasper	Grayish White Chert	Brownish Black Chert	Reddish White Chert	Chalcedony
Primary Decortication Flake:					
Primary Decorticcation Flake Fragment:	1				
Secondary Decortication Flake:					
Secondary Decortication Flake Fragment:					
Interior Flake with Cortex:					
Interior Flake with Cortex Fragment:					
Interior Flake:	2	1			
Interior Flake Fragment:		6			
Primary Shatter:					
Secondary Shatter:					

Total Number of Silica Debitage Pieces:	31
Number of Heat Alteration Debitage Pieces:	10
Percentage of Heat Alteration Debitage Pieces:	32%

Summary and Discussion

Site 42Ws1629

The lithic artifact assemblage recovered from Site 42Ws1629 consists of 21 tools and 100 pieces of debitage. The total assemblage results from the excavation of 13 1-m x 1-m units within and immediately in front of the rockshelter. The excavations revealed that the stratigraphy in the western section of the rockshelter had been heavily mixed by rodent burrowing and partially dug out by artifact collectors, while the eastern section appears to have been left relatively intact. Four distinct stratigraphic units were identified, three of which display separate occupational episodes. The lowermost Stratum D represents a probable Pueblo I period Virgin Anasazi occupation; Stratum C reflects a period of relatively light Pueblo II Virgin Anasazi occupation; and Strata B and A are associated with relatively intensive Southern Paiute use (see Chapter IV).

Approximately 70% of the stone artifacts recovered from the rockshelter came from Strata A and B. No lithic artifacts were recovered from Stratum C and only 2 flakes from Stratum D. Surface artifacts consist of 6 tools and 28 pieces of debitage. It is strongly believed that the surface artifacts scattered along the slope leading down from the rockshelter were originally from the dug-out section of the shelter. Table 6.15 lists the artifacts retrieved per stratum.

TABLE 6.15. Lithic Artifacts per Stratum at Site 42Ws1629.

SURFACE - 34 items

1	Elko Corner-notched projectile point reworked into a knife
1	Utilized flake (Group I)
1	Utilized flake (Group II)
1	Hammerstone
1	Mano fragment
1	Grinding slab fragment
28	Debitage

STRATUM A - 53 items

1	Eastgate Expanding Stem projectile point
1	Cottonwood projectile point
1	Biface fragment
1	Scraper
1	Graver/perforator
1	Patterned core
1	Hammerstone
1	Abraded cobble tool
2	Mano fragments
1	Grinding slab fragment
42	Debitage

STRATUM B - 32 items

1	Desert Side-notched projectile point
2	Biface Fragments
1	Utilized flake (Group II)
28	Debitage

STRATUM D - 2 items

2	Debitage

The artifacts recovered from Strata A and B are believed to be associated with the Southern Paiute occupation. Diagnostic artifacts include both Desert Side-notched and Cottonwood Triangular projectile points, and over 491 Southern Paiute utility ware sherds (see Chapter V).

A number of specific activities are evident from the number and frequencies of stone tools present in the Southern Paiute assemblage. The projectile points, knife/biface fragments, the scraper, and the utilized flakes which exhibit scraping attributes are considered indicative of activities associated with hunting and faunal resource processing. It is interesting to note that edge wear damage on most of the cutting and scraping tools is extensive, indicating many episodes of use. Compounded by these tools are over 103 faunal fragments, representing such species as mule deer, mountain sheep, cottontail, and hare. Over half of the faunal remains are burned.

Cobble tools include 2 hammerstones and an abraded cobble tool. These artifacts probably were used to reduce floral and faunal substances to a desired state and to maintain the work surfaces of ground stone implements.

The processing of vegetal resources is indicated by the recovery of 3 mano and 2 grinding slab fragments. Use-wear on the mano fragments indicates that the implements were used on concave and flat grinding surfaces.

Debitage accounts for 83% (N=100) of the lithic assemblage (Table 6.1). Most of the debitage are interior flakes (59%), followed by shatter (23%), interior flakes with cortex (10%), and lesser amounts of primary (4%) and secondary (4%) reduction flakes. The material types identified among the debitage include combined cherts (32%), obsidian (28%), quartzite (16%), jasper (13%), and chalcedony (11%). An obsidian flake (Sample No. 2146) submitted to A & G Analyses for geologic source analysis revealed that the material is derived from the Modena area, Iron County, Utah (Appendix E).

It is apparent from the above debitage tabulations that primary and secondary core reduction activities rarely occurred at the site. The only evidence of primary reduction consists of 3 obsidian and 1 chalcedony primary decortication flakes. An inspection of the debitage table for the site shows that all obsidian flake reduction stages, with the exception of secondary decortication flakes, are present. Given that only 28 pieces of obsidian debitage occur in the assemblage, it is assumed that these waste flakes represent the by-products from the manufacture of one bifacial tool. If such is the case, the reduction techniques can be described as follows: 3 primary decortication flakes exhibiting a whitish cortex patina were each detached from a semi-round nodule of obsidian. A mean platform size/ thickness of 3.5 mm and the large bulbs of percussion indicate that the 3 primary flakes were initially detached by hard hammer percussion. Additional hard hammer thinning of the obsidian core is evident by 3 interior flakes displaying cortex on the striking platforms. The mean for the size/thickness of the hard hammer interior flake striking platforms is the same as that for the 3 primary flakes. The twelve pieces of primary shatter are probably directly associated with the initial reduction of the obsidian nodule.

Soft hammer bifacial thinning constitutes the second phase of reducing the obsidian core into a usable tool form. This technique is substantiated by the 20 interior flakes which exhibit thinner striking platform means, diffuse bulbs of percussion, and lipping.

With the exception of the probable production of one obsidian tool from an obsidian nodule, the dominant lithic production mode was secondary reduction oriented mainly towards tool maintenance and possibly limited tool production. It would appear that most of the tools were either carried onto the site as finished pieces or pre-reduced blanks. This assumption is indirectly supported by the number of heat-altered flakes present in the debitage inventory. Table 6.8 reveals that of a total of 56 silica debitage pieces, 24 show evidence of heat alteration. Most of the heat-treated debitage are interior flakes detached from heat-treated bifacial implements. Heat-altered material types include jasper (N=12), grayish white chert (N=7), chalcedony (N=3) and brownish black chert (N=2). Considering the diversity in raw material types subjected to heat alteration and the relatively low number of flakes from each material type, it is felt that most of the debitage originated from the maintenance and/or rejuvenation of existing, preheat-treated tools.

In summary, the artifact assemblages from Stata A and B are considered to be components of a Southern Paiute occupation. With the exception of the projectile points, there appears to be no apparent technomorphological difference in the flaked stone assemblage from that of Anasazi assemblages familiar to the author . Whether or not the individual tools were manufactured by Southern Paiutes or recycled from previous occupants is of little consequence. What is important is that the tools themselves imply that a wide variety of subsistence activities occurred at the site.

Site 42Ws1630

A total of 46 lithic artifacts were recovered from the excavation of 17 1-m x 1-m units. The stone tools present in the assemblage number 12 (25%) and debitage constitutes the remainder. The majority of the artifacts (N=27, 56%) were recovered from the top stratum of the rockshelter, 12 pieces of debitage were recovered from Stratum 3, and the rest of the lithic artifacts (N=9) were retrieved from the contents of Feature 1, an intrusive roasting pit. Table 6.16 lists the artifacts found per stratum.

The tools recovered from Stratum A can be divided into three distinct groups: chipped stone tools, cobble tools, and ground stone tools. All three categories imply that a variety of activities occurred at 42Ws1630. The chipped stone tools indicate that hunting and faunal processing were of some importance. Edge wear damage on both the scraper and the utilized flake revealed that the tools were used on substances of moderate resistance, such as hide or wood working, though plant resource processing can not be ruled out.

The cobble tools include one heavily-battered quartzite hammerstone and an abraded cobble, both of which can be associated with either the processing of vegetal remains and/or the maintenance of ground stone tools.

TABLE 6.16. Lithic Artifacts per Stratum at Site 42Ws1630.

STRATUM A - 27 items	
1	Cottonwood projectile point
1	Protohistoric projectile points
1	Scraper
1	Utilized Flake (Group I)
1	Multi-directional core
1	Hammerstone
1	Abraded cobble tool
1	Mano fragment
17	Debitage

STRATUM B - 12 items	
12	Debitage

FEATURE 1 - 9 items	
1	Knife Fragment
1	Biface Fragment
1	Utilized flake (Group II)
1	Graver
5	Debitage

The end piece of a probable subrectangular mano was the only ground stone implement found at the site. A second implement may have also served as a grinding tool. The abraded cobble exhibits abrasion to such a degree that it may have been used to crack and grind small seeds.

Stratum C yielded twelve pieces of debitage and no tools. The artifacts recovered from the contents of Feature 1 consist of 4 tools and 5 pieces of debitage. These artifacts are probably associated with the Stratum A assemblage.

Debitage from the combined strata totals 34 pieces (Table 6.2), a rather small quantity when compared with the number and diversity of tools. Most of the debitage consist of interior flakes (56%), followed by interior flakes with minimal cortex (26%) and shatter (15%). The raw material types include combined cherts (38%), chalcedony (21%), obsidian (18%), quartzite (18%) and jasper (5%). Two obsidian flakes submitted to A & G Analyses were identified as deriving from the Modena obsidian source area (Appendix E). Only one primary reduction flake occurs in the collection. It would appear that primary reduction of an unaltered piece of raw material to produce cores/blanks, or usable primary flakes, did not occur at the site. The presence of 19 interior flakes also suggests that very limited tool production occurred. Overall, the debitage percentages indicate that the majority of the finished tools were either brought to the site or scavenged/recycled from other artifact scatters present in the immediate area.

The most recent temporal occupation of Stratum A can comfortably be assigned to the Late Numic Protohistoric period based on the two projectile points, and the modern C-14 date from the roasting pit. However, the artifact inventory from Stratum A can not be considered a homogeneous protohistoric assemblage due to the disturbed nature of the rockshelter. Stratigraphic investigations have shown that the strata are very shallow, have been extensively disturbed and remixed by rodent activity, and have undoubtedly been partially cleaned out by previous prehistoric short-term residents.

Site 42Wsl631

Archaeological investigations at Site 42Wsl631 entailed the excavation of a 1.4 x 1.4 meter area at the opening/mouth of a collapsed rockshelter. Five stone tools and fourteen pieces of debitage were recovered from the excavation unit. Most of the lithic artifacts were found a few centimeters below or immediately on the ground surface. Stone tools include one hammerstone, one abraded cobble tool, one wedge, and two utilized flakes (Group I). Debitage consists mostly of interior flakes (79%) of chert, obsidian, and jasper (Table 6.3). Approximately four of the interior flakes show evidence of heat-alteration.

Site 42Wsl632

The lithic artifact assemblage from Site 42Wsl632 was recovered exclusively from the midden deposit. A large rockshelter located upslope from the midden deposit had been effectively sealed off by the collapse of several large sandstone spalls which formed the ceiling. It is felt that the trash midden was associated with a residential camp now buried below the collapsed rockshelter. Ceramics recovered from the midden deposit indicate occupation during the Pueblo I and II Virgin Anasazi period, and later by Southern Paiutes (see Chapter V).

A total of 46 tools and 136 pieces of debitage were retrieved from the excavation of 15 1-m x 1-m units. No distinct cultural stratigraphic levels could be recognized in the mixed depositional profile of the trash midden. Hence, the midden deposit was excavated in arbitrary 10-cm levels. Table 6.17 lists the artifacts found per level.

The separation of the lithic artifact collection into cultural assemblages is not possible due to the mixed contextual displacement of the midden deposits. The only diagnostic temporal artifacts found are the Desert Side-notched and Cottonwood Triangular projectile points believed to be associated with the Southern Paiute occupation.

Overall, the lithic collection shares technological and morphological characteristics similar to the collection from Site 42Wsl629. Formal bifacial tools, such as projectile points and bifaces, display well-controlled parallel flaking and rather thin cross-sections. Most of the biface fragments exhibit extensive edge wear from heavy use and numerous episodes of resharpening. All of the formal tools were manufactured from cryptocrystalline silicates and, judging by the relatively low number of debitage, the majority of the bifacial tools appear to have not been manufactured at the site.

Cutting and scraping implements such as scrapers, wedges, retouched flake tools, and utilized flakes, for the most part, are expedient tools manufactured from either reduction flakes or from other broken tool forms. Five of the tools displaying edge utilization traces common to a scraping function were made from large quartzite cobble primary and secondary flakes.

TABLE 6.17. Lithic Artifacts per Level from Site 42Wsl632.

SURFACE - 5 items

1	Scraper
2	Hammerstones
1	Abraded cobble tool
1	Mano fragment

LEVEL 1 - 60 items

1	Desert Side-notched projectile pt.
2	Biface fragments
1	Wedge
2	Utilized flakes (Group I)
1	Graver/perforator
4	Hammerstone resharpening flakes
2	Mano fragments
1	Grinding slab fragment
46	Debitage

LEVEL 2 - 31 items

1	Biface fragment
1	Wedge
2	Retouched flake tools
1	Utilized flakes (Group I)
1	Hammerstone resharpening flake
25	Debitage

BLM TRENCH (1-50 cm) - 84 items

1	Eastgate Expanding Stem projectile point
1	Cottonwood Triangular projectile point
1	Projectile pt. tip fragment
3	Biface fragments
1	Scraper
1	Wedge
1	Utilized flake (Group I)
1	Utilized flake (Group II)
1	Multi-directional core
1	Grooved sandstone abrader
2	Mano fragments
5	Grinding slab fragments
65	Debitage

These tools exhibit wear that indicates usage on substances of moderate resistance. In such cases it is probably correct to conclude that raw material selection for tool types was largely conditioned by the relationship of grain size and siliceousness with regard to functional suitability.

Debitage from the site numbers 136, accounting for 75% of the chipped stone collection (Table 6.4). Most of these, 44%, are interior flakes; 22% are flake shatter; 15.5% are interior flakes with cortex; 15.5% are secondary decortication flakes; and the remaining 3% are primary decortication flakes. Nineteen of the silica debitage pieces show signs of heat alteration. The material types identified among the debitage, listed in order of dominance, include combined cherts (34%), obsidian (29%), jasper (18%), quartzite (15%), and chalcedony (4%). One obsidian flake submitted to A & G Analyses was identified as deriving from the Modena obsidian source area (Appendix E).

In summary, the chipped stone artifacts from Site 42Wsl632 indicate that a variety of activities occurred at the site. These include faunal and vegetal resource procurement and processing, limited expedient tool production, and maintenance of formal tools. Overall implications support the inference that Site 42Wsl632 served as a short-term residential camp for groups of Pueblo I and II Virgin Anasazi and Southern Paiute peoples.

Site 42Ws1633

Site 42Ws1633 is the largest rockshelter excavated at the Washington City-Green Spring project. Four stratigraphic units were defined, with Stratum C being the primary artifact-bearing unit. A total of 9 stone tools and 10 pieces of debitage were recovered from Stratum C (Table 6.18).

No radiocarbon dates are available for the rockshelter. Charcoal was present throughout the fill but was too small and scattered to obtain a reliable sample. Ceramic cross-dating from Stratum C generally indicates a Pueblo II period Virgin Anasazi occupation and a subsequent Southern Paiute occupation. Additional support for a historic Southern Paiute occupation comes from certain diagnostic historic artifacts that predate A.D. 1900 (see Chapter V).

TABLE 6.18. Lithic Artifacts from Stratum C at 42Ws1633.

Stratum C - 19 items

1	Protohistoric side-notched projectile point
1	Reworked Gypsum projectile point
1	Projectile point tip fragment
1	Biface fragment
1	Retouched flake tool
2	Utilized flakes (Group II)
1	Patterned core
1	Hammerstone
10	Debitage

The projectile points recovered from Stratum C did not provide any firm temporal placements for the occupational episodes at the rockshelter. A Gypsum point reworked into a knife indicates that the point was recycled but by what occupational group is unknown. The side-notched projectile point is stylistically indeterminate but felt by the author to be late Protohistoric due to its crude workmanship and expedient nature. The last point was an indeterminate obsidian arrow tip fragment manufactured from obsidian occurring in the Wild Canyon area, Mineral Mountain Range, Beaver County, Utah (Appendix E).

The main activity that appears to have been conducted at the rockshelter was faunal processing and consumption. Evidence supporting this interpretation is based on the large number of recovered faunal remains and the associated faunal processing tool kit. Over 411 bone fragments were collected, representing 17 different species from the mammal, reptile, and bird families. Approximately 18% of the bone fragments were heavily broken and burned (Mead, Appendix B). It is interesting to note the presence of bison remains in the faunal assemblage.

The stone tools that may have been used in the butchering and processing of the faunal remains consist of one well-made retouched flake tool, two utilized flakes, and possibly the reworked Gypsum point and the biface fragment. The retouched flake tool displays extensive well-patterned bifacial pressure retouch while the opposite margin appears to have been purposely blunted, perhaps to facilitate hafting. All three of the flake tools exhibit edge damage of rounding and polish with light to moderate bifacial microflaking. Such utilization traits are often equated to a cutting function (Ahler 1979).

There is little literature available for determining the number of stone tools necessary in processing faunal remains. Several butchering experiments have shown that either a single biface or an unretouched flake could accomplish the butchering (including deboning) of a white-tail deer (Patterson 1976). Furthermore, Patterson felt that both the flake and the biface could have effectively been used again for one more butchering episode before they would have needed resharpening (Patterson 1976). For the butchering activities conducted at Site 42Wsl633, the number of tools employed probably included a combined usage of hafted cutting implements and expedient flakes, of which the latter was probably discarded after one butchering episode.

Little can be derived from the small debitage collection (N=19) other than that interior flakes constitute most of the assemblage and that obsidian (N=8) was the dominant raw material type (Table 6.5).

Site 42Wsl634

Excavation at this small rockshelter revealed the only stratigraphy from the entire project that had not been disturbed by roden burrowing, erosional processes, or human vandalism. Three strata were defined. Only two stone tools and four pieces of debitage were recovered. The first consists of a small white chert biface midsection found in Stratum A. The second tool was found on the modern ground surface and is a slightly abraded hammerstone. Debitage consist of 3 grayish white chert interior flakes and 1 quartzite secondary decortication flake.

A radiocarbon sample submitted from Stratum A yielded a date of 150±50 B.P. (A.D. 1800±50). Although no diagnostic artifacts were recovered, it is felt that this date is probably associated with a Southern Paiute occupation.

Site 42Wsl828

Feature 6, located on the ridge slope immediately below the rockshelter at Site 42Wsl633, yielded 13 lithic artifacts. These include 1 denticulated tool, 1 hammerstone resharpening flake, 2 grinding slab fragments, and 9 pieces of debitage. These artifacts probably were used for processing plant material in association with the use of Feature 6 as a roasting pit.

CHAPTER VII

HISTORIC ARTIFACTS

Introduction

Historic artifacts recovered from the Washington City-Green Spring project consist of one small piece of wool trade cloth, a solid point bullet, and 18 ammunition cartridges. It is of some interest to note that no modern artifacts post-dating the 1940s were found in the upper levels of any of the rockshelter excavation units. This absence of modern Euro-American ethnic trash is unusual considering the fact that a large housing development occurs a short distance to the east of the project area.

Analyses of the historic artifacts were conducted by three specialists. Dr. Ann Hedlund, Department of Anthropology, Arizona State University, analyzed the textile fragment to determine the type of fabric dye; Dr. David Wenger, University of Colorado, performed a spectrophotometric analysis of the textile fragment to determine the type of fabric dye, and Mr. Mark Bond, Albuquerque, identified the ammunition cartridges.

Textile Fragment

A small piece of red wool trade cloth was recovered from within the rockshelter at Site 42Ws1633 during the 1984 Bureau of Land Management testing program (Dalley 1984). The textile fragment measures 43 mm in length and 45 mm in width and had been deliberately cut into a triangular shape from a parent cloth of diagonal 2/2 balanced twill weave. The fiber is sheep's wool and the yarn is a single-ply yarn with a Z twist. The edges of the cloth are fairly cleanly cropped and are aligned with the yarn interlacement (Dr. Ann Hedlund: personal communication). A small yarn sample from the cloth was submitted to Dr. David Wenger, University of Colorado, for dye testing. Spectrophotometric analysis revealed that the wool was dyed with cochineal, an imported natural insect dye (Dr. Wenger: personal communication).

According to Dr. Hedlund, cochineal was the predominant red dye used during the 1860s to about 1875. Moreover, trade cloth such as this was frequently used in the Plains and Southwest to trim handicrafts, such as the bound edges of bags, moccasins, and insets along beadwork on garments. The use of red wool cloth to decorate Ute leather leggings is illustrated in the current report A Nineteenth Century Ute Burial From Northeast Utah (Fike and Phillips 1984: Figure 51, p. 57). There is a good possibility that the red cloth piece is associated with the badly disturbed remains of the human burial recovered from the rockshelter (see Appendix D).

Ammunition

A total of 18 ammunition cartridges and 1 bullet was collected from Sites 42Ws1629, 42Ws1632, and 42Ws1633. Frequencies of ammunition cartridges from the three sites are summarized in Table 7.1 and Figure 7.1 illustrates cartridge types and headstamps. The cartridge collection includes 3 varieties, each of which is described below.

TABLE 7.1. Summary of Ammunition Cartridges from Project Sites.

Site Number	.22 Long/ Long Rifle	.22 Short	.22 Extra Long	.44-40	12-Gauge	Totals	(%)
42Ws1629	11	1	1	1	1	15	(83%)
42Ws1632	1					1	(6%)
42Ws1633	1	1				2	(11%)
Totals	13	2	1	1	1	18	

.22 Caliber

Four types of .22 caliber cartridges were identified among the 16 specimens. The most frequent type is the .22 caliber Long or Long Rifle, of which 13 specimens were found. The .22 Long was developed as early as 1871 as a black powder revolver load, while the .22 Long Rifle was developed in 1887 by the J. Stevens Arms and Tool Company (Barnes 1965:274; Herskovitz 1978:47). Both Long and Long Rifle utilized cases of identical dimensions. Two different discernible head stamps identified 10 Winchester Long Rifle cartridges, and 3 Union Metallic Cartridge Company Long cartridges. The Winchester Repeating Arms Company introduced the .22 caliber Long Rifle to the market in 1887 (Barnes 1965:274).

In addition to Long and Long Rifle .22 cartridges, one Extra Long .22 cartridge was recovered. This cartridge was introduced in 1880 by Union Metallic Cartridge Company and was chambered for Ballard, Remington, Stevens, Smith and Wesson, and Winchester .22 caliber arms (Barnes 1965).

Two Henry .22 Short cartridges constitute the remainder of the .22 caliber cartridges found at the Washington City-Green Spring project. This round, which was developed by Daniel Wesson in 1857 for the Smith and Wesson First Model Revolver, is one of the oldest commercially produced, self-contained metallic cartridges (Barnes 1965:273). The .22 caliber Short is still extensively loaded and used today.

The absolute temporal placement of the .22 caliber cartridges is unknown; however, according to Barnes (1965), crimping of .22 cartridges first appeared at the turn of the century (A.D. 1900). Thus, of the 16 .22 caliber Washington City-Green Spring cartridges, only two are crimped, indicating that 14 pre-date A.D. 1900.

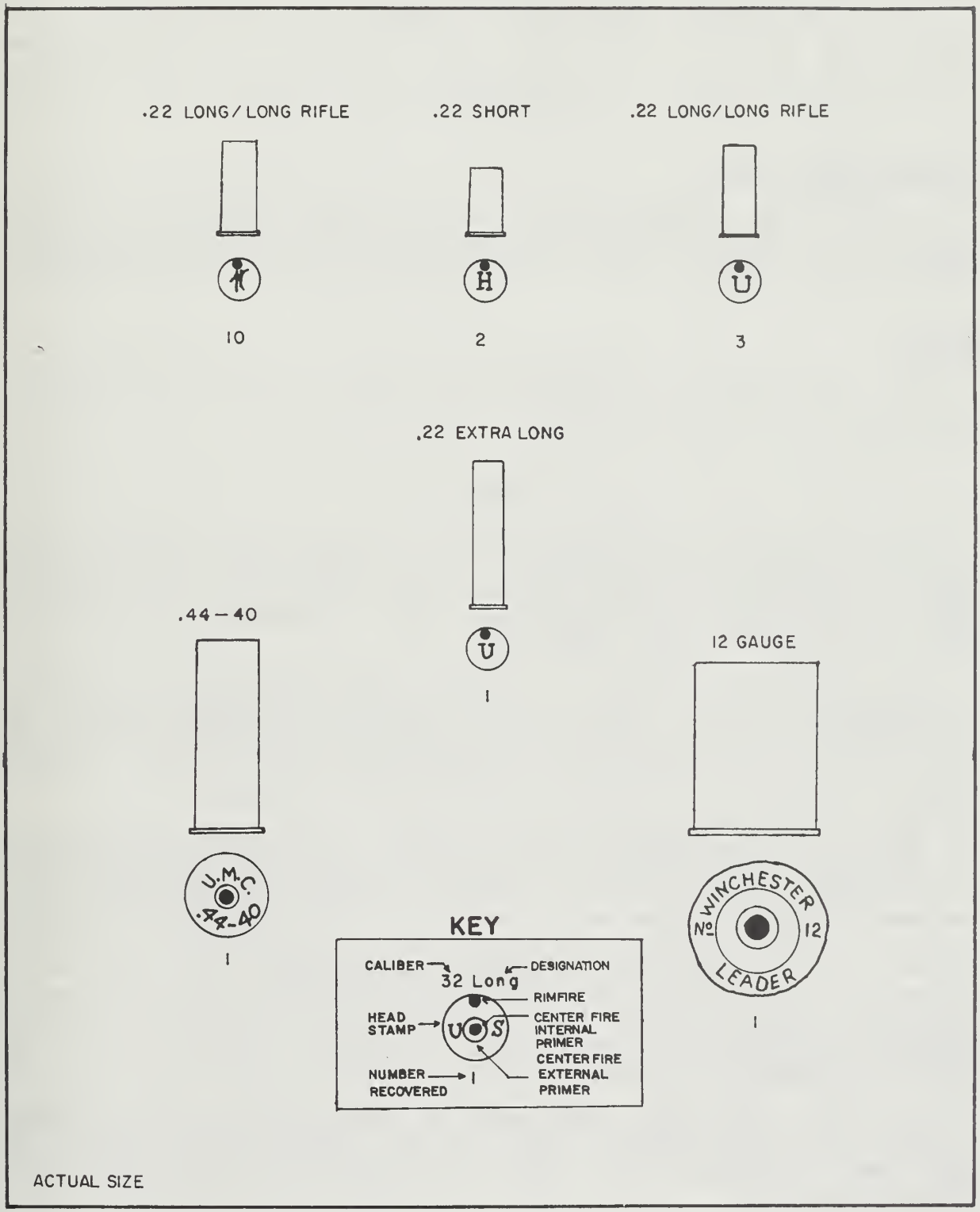

FIGURE 7.1. Ammunition Cartridge Types and Headstamps.

.44 Caliber

One .44-40 caliber cartridge manufactured by Union Metallic Cartridge Company was uncovered at Site 42Ws1629. The .44-40 round was first made for use in the Winchester Model 1873 rifle and the Colt Single-Action revolver (Herskovitz 1978:49). Barnes states that "just about every American arms manufacturer has offered some weapon chambered for this round" (1965:61). No American-made rifles have been chambered for this round since 1937 and the last pistol made to use this round was in 1942 by Colt.

12-Gauge Shotgun Shell

One 12-gauge Winchester/Leader shotgun shell was discovered at Site 42Ws1629. The 12-gauge Winchester/ Leader was manufactured by the Winchester Repeating Arms Company. It was first introducted in 1894 and was discontinued in 1943 (Vinson 1968:71).

Bullet

One spent solid point bullet from a Winchester Long Rifle cartridge was recovered from Site 42Ws1629.

Summary

Chronological data from the historic artifacts tentatively suggests a historic Southern Paiute occupation of the project area. Cochineal-dyed wool trade cloth was prevalent from the 1860s to about 1875, and complements Fowler and Fowler's (1971) ethnohistoric record of Southern Paiute occupation of the St. George Basin during the 1870s.

The ammunition cartridges and solid point bullet from Sites 42Ws1629, 42Ws1632, and 42Ws1633 are items of obvious Euro-American manufacture. Approximately 14 of the .22 caliber cartridges pre-date 1900, while the .44-40 caliber cartridge and the 12-gauge shotgun shell can fall anywhere within the temporal range of 1873-1937 and 1894-1943, respectively.

Nine of the cartridges were recovered from Level 1 within the rockshelter at 42Ws1629. Their proveniences correspond to the area immediately behind the low-lying masonry wall contructed of 2 to 3 courses of unmortared, unshaped, tabular sandstone rocks (see Chapter IV). This rock wall is felt to be of relatively recent construction and may have served as a hunting blind. The rock wall extends partially across the western mouth of the rockshelter and is oriented so as to provide an excellent view of the spring area and the west ridge trough leading to the spring. The cartridges recovered from the rockshelter consist of seven .22 caliber cartridges, one .44-40 caliber cartridge, and the 12-gauge shotgun shell.

We do not know which ethnic group or groups deposited the cartridges at the three sites; however, there is a good possibility that some of the items may be associated with the historic Southern Paiute occupation of the spring area.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Introduction

The investigation of six rockshelters and a series of seven outdoor hearths in the Washington City-Green Spring project area has documented human occupation of the Green Spring area during the prehistoric Virgin Anasazi and historic Southern Paiute/Anglo-American time periods. This chapter summarizes the results of the data analyses and addresses the research problems previously discussed in Chapter III.

To recapitulate, the goal of the proposed study was to demonstrate the significance of the Washington City-Green Spring sites for yielding information pertinent to understanding cultural and historical processes in the St. George Basin of southwestern Utah. Current literature concerning the prehistory of southwestern Utah shows that there is a high degree of variability in site types in different geographical areas. These differences may reflect different subsistence orientations and group mobility strategies, such as seasonal hunting and gathering, mixed hunting/gathering/horticulture, and intensive agriculture. Some authors have suggested that the prehistoric Virgin Anasazi also may have followed a seasonal subsistence pattern similar to that of the Southern Paiute (Janetski and Hall 1983), while others contend that the Virgin Anasazi were primarily sedentary agriculturalists (Shutler 1961; Aikens 1966). Other research has shown that different groups within the Virgin Anasazi cultural tradition may have practiced different subsistence strategies contemporaneously in different localities (Moffit et al. 1978; Nickens and Kvamme 1981; Westfall 1985a). If such was the case, then systems of exchange may have facilitated human survival in an arid region where access to food resources was constrained by environmental factors.

In order to test these alternative models of prehistoric behavior, the recovery and analyses of data were oriented toward answering questions relevant to identifying the material correlates of chronology, environment and subsistence, technology, exchange, and the logistical organization of subsistence-related activities.

Chronology and Cultural Affiliation

The Washington City-Green Spring rockshelters were probably first occupied during the Pueblo I period (ca. A.D. 900-1050) by Virgin Anasazi groups, who continued to utilize them for resource procurement and processing activities into the succeeding Pueblo II period (ca. A.D. 1050-1150). The subsequent occupation by the Southern Paiute seems to have occurred much later, as indicated by one radiocarbon date of 150±50 B.P. (A.D. 1800) from 42Ws1634, and radiocarbon dates of 140±60 B.P. (A.D. 1810) and 80±60 B.P. (A.D. 1870) from two outdoor hearths (42Ws1828 - Features 3 and 4). Radiocarbon samples

from other hearths yielded "Modern" dates spanning the period A.D. 1850 to 1950. These dates are compatible with the first three historic dates and could indicate Southern Paiute occupation of the Green Spring area into the modern era. However, since no modern trash was found in the cultural deposits, these "Modern" dates most likely are relevant to the earlier historic period.

In a regional context, the relative dates of the Virgin Anasazi occupation of the Washington City-Green Spring sites are compatible with absolute and relative dates for other investigated Pueblo I-II Virgin Anasazi habitation and camp sites in southwestern Utah and northeastern Arizona: the Red Cliffs Site, Washington County, Utah (Dalley and McFadden 1985); the Kanab Site, Kane County, Utah (Nickens and Kvamme 1981); sites in the Beaver Dam Mountains, Washington County, Utah (Moffit et al. 1978); and sites in the Vermilion Cliffs area of Kane County, Utah (Westfall 1985a). These provide a contemporaneous, comparative data base against which to evaluate the Washington City-Green Spring project archaeological data.

Table 8.1 provides a summary of the Washington City-Green Spring project radiocarbon dates, together with published dates from other investigated Southern Paiute sites in the general region. It is obvious that, relative to surrounding areas of documented Southern Paiute occupation, the Green Spring area apparently was not occupied by the Southern Paiute until well into the historic period, just prior to the period of Mormon colonization. The span of "Modern" dates, together with the known dates of historic Euro-American artifacts ranging from A.D. 1870 to the turn of the century, is consistent with the known Southern Paiute ethnohistoric data for the St. George Basin.

Environment and Subsistence

As stated previously (Chapter III), Green Spring is a small oasis in the low desert of the St. George Basin. The pollen spectra from the rock-shelter sites and the modern samples reveal that the prehistoric environment was similar to that of today. Groups who were encamped at Green Spring would have had access to a variety of upland, low desert, riverine, and aquatic (spring) plant and animal resources within a 5 to 7 mile radius around the spring (Hevly and Edwards, Appendix A). Small-scale horticulture might have been feasible in the vicinity of the spring during the prehistoric period, but this could not be confirmed by the available data. Economically significant plant species represented in the botanical record from the Washington City-Green Spring sites are summarized in Table 8.2, and Table 8.3 lists documented ethnographic uses of these plants by the Southern Paiute. It is assumed that Virgin Anasazi groups may have also used these plants and that seasonal procurement scheduling may have been similar to that of the Southern Paiute. The representation of several arboreal species such as Pinus, Juniperus, and Quercus and non-arboreal species such as Cheno-ams, Ephedra, and Artemisia could be due in part to long-distance wind transport as well as by cultural activities. On the other hand, the recovery of cut and pounded Juniperus bark matting from 42Ws1633 shows that this plant was in fact procured from an upland locality.

TABLE 8.1. Summary of Published Radiocarbon and Thermoluminescence Dates for Southern Paiute Sites.

Source	Location	Dates
This Volume	Washington City-Green Spring, Utah	
	42Ws1630 - Feature 1	Modern
	42Ws1631	Modern
	42Ws1634	A.D. 1800±50
	42Ws1828 - Feature 1	Modern
	42Ws1828 - Feature 2	Modern
	42Ws1828 - Feature 3	A.D. 1810±60
	42Ws1828 - Feature 4	A.D. 1870±60
	42Ws1828 - Feature 6	Modern
	42Ws1828 - Feature 7	Modern
Fowler et al. 1973	Conaway Shelter, Nevada	A.D. 1720
Moffit et al. 1978	Beaver Dam Mts., Utah	
	NA11,1404	A.D. 1615
	NA11,1405	A.D. 1755
	NA11,500	A.D. 1505
	NA11,634	A.D. 1420
Tucker 1985	Jackson Wash, Utah	
	42Ws1578	A.D. 1771-1809*
	42Ws1578	A.D. 1491-1589*
Westfall 1985b	Vermilion Cliffs, Utah	
	42Ka2605	A.D. 1310±

* Thermoluminescence dates; all others are radiocarbon assays.

The faunal bone assemblage from the rockshelter sites, most notably from 42Ws1629 and 42Ws1632, include the following species: Bison/Bos, Canis latrans (coyote), Crotalus (rattlesnake), Dipodomys (kangaroo rat), Lepus (jackrabbit), Masticophis, (coachwhip snake), Neotoma (packrat), Odocoileus (deer), Ovis canadensis (bighorn sheep), Pituophis (gopher snake), Reithrodontomys (harvest mouse), Sylvilagus (cottontail), Taxidea taxa (badger), and Thomomys (pocket gopher). Of these, the bones of Bison/Bos, Lepus, Odocoileus, Ovis canadensis, and Sylvilagus were burned, indicating that they were probably consumed by humans. Inasmuch as the rockshelters provided habitats for snakes, rodents, and canines (who might have brought killed prey to the rockshelters), the unburned, if fragmentary, condition of the bones of these species cannot be confirmed as human dietary items.

TABLE 8.2. Summary of Economic Plant Species in the Botanical Record.

x = Pollen
o = Macrofloral

	42Ws1629 Stratum A-B	42Ws1629 Stratum C	42Ws1629 Stratum D-Floor	42Ws1630 Stratum B	42Ws1630 Stratum C	42Ws1631	42Ws1632	42Ws1633	42Ws1634	42Ws1828 Feature 3	42Ws1828 Feature 4	42Ws1828 Feature 7
UPLAND TREES & SHRUBS												
Agave/Yucca												
Cercocarpus			x	o			x					
Juniperus	x	x	x		x	x	x	o	x	x	x	
Pinus	x	x	x		x	x	x	x	x	x	x	x
Quercus	x	x	x		x	x	x	x	x	x		
Rhus	x	x	x									
Stipa					o			o				
LOW DESERT SUCCULENTS & SHRUBS												
Echinocereus	o											
Ephedra	x	x	x		x	x	x	x	x	x	x	x
Opuntia	x		x			x	x		x			
AQUATIC TREES & HERBS												
Cyperaceae	x		x		x		x					
Phragmites								o				
Populus/Salix	x		x		x							
Prosopis	x	x	x				x			x	x	
Typha	x		x						x			
MIXED HERBS & SHRUBS												
Allium			x			x		x		x	x	
Aristida								o				
Artemisia	x	x	x		x	x	x	x	x	x	x	x
Brassicaceae	x	x			x				x			
Calochortus											o	
Chenopodium-Amaranthus	x	x	x		x	x	x	x	x	x	x	
Chrysothamnus								o				
Polygonaceae	x	x	x				x					
Solanaceae							x					
Zea						x				x		
TOTAL SPECIES	15	10	15	1	10	9	12	11	9	9	8	3

TABLE 8.3. Ethnographic Uses of Plants by the Southern Paiute.

PLANT NAME	FOOD	FUEL	MEDICINE	TECHNOLOGY	SOURCE
AMARANTHACEAE					
Amaranthus sp.	x				1, 3
AMARYLLIDACEAE					
Agave sp.	x				1, 2, 3
ANACARDIACEAE					
Rhus sp.	x			x	1
BORAGINACEAE					
cf. *Cryptantha* sp.	x			x	1
CACTACEAE					
**Echinocereus* sp.					
Opuntia sp.	x			x	1, 2, 3
CHENOPODIACEAE					
Atriplex sp.	x				1
Chenopodium sp.	x				1, 2
COMPOSITAE					
Artemisia sp.		x	x	x	1
**Chrysothamnus* sp.					
CUPRESSACEAE					
Juniperus sp.	x	x		x	1, 2, 3
EPHEDRACEAE					
Ephedra sp.			x		1
FAGACEAE					
Quercus sp.	x				1
GRAMINEAE					
**Aristida pupurea*					
Phragmites australis	x			x	1, 3
**Stipa speciosa*					
HYDROPHYLLACEAE					
cf. *Eriodictyon* sp.			x		1
LEGUMINOSAE					
Prosopis sp.	x	x			1
LILIACEAE					
Allium sp.	x				1
Calochortus sp.	x				1
Yucca sp.	x			x	1
PINACEAE					
Pinus spp.	x	x		x	1, 2, 3
POACEAE					
Zea mays	x				1, 2, 3
POLYGONACEAE					
cf. *Eriogonum* sp.	x				1
ROSACEAE					
**Cercocarpus* sp.					
SALICACEAE					
Populus sp.				x	3
Salix sp.				x	3
SOLANACEAE					
cf. *Datura* sp.			x		
cf. *Nicotiana* sp.			x		1
cf. *Solanum* sp.	x				1
TYPHACEAE					
Typha sp.	x				1
UMBELLIFERAE					
cf. *Ligusticum*			x		1
ZYGOPHILLACEAE					
Larrea sp.			x	x	1

1. Bye 1973
2. Euler 1966
3. Kelly 1964

* No published references, although these species were represented in the project macrofloral assemblage.

To summarize, the botanical and faunal data show that both low desert and upland plant and animal species were present, and were acquired by the inhabitants of the rockshelters. Different relative frequencies of different species have implications for evaluating selective emphases on certain plants and animals, which in turn reveal the logistical and seasonal organization of subsistence-related activities. To wit: if a site functioned as a short-term camp for specialized task groups deployed from a residential base for the purpose of collecting certain resources, then botanical and faunal data should reveal relatively low variability in species composition and an emphasis on local low desert and aquatic species. On the other hand, if a site was occupied as a residential base for a longer period of time by groups engaged in a predominantly foraging strategy (incorporating hunting, gathering, and horticulture), then floral and faunal inventories should show greater variability in species composition than that represented for a specialized collecting or hunting camp (see Chapter III). To facilitate discussion, the various culture-temporal components represented at all the sites are shown in Table 8.4, together with the subsistence activities and seasonal schedules inferred from the botanical and faunal data.

Site 42Ws1629, the easternmost rockshelter, located at the toe of the ridge and nearest to Green Spring, is distinguished by a highly variable pollen spectrum. The pollen record from this site includes the most substantial representation of upland trees and shrubs, riparian trees, aquatic herbs, desert succulents and shrubs, and various dryland grasses, herbs, and shrubs. Economic plants represented in the pollen spectrum occurring in the immediate vicinity include Opuntia, Prosopis, Allium, Polygonaceae (cf. Eriogonum), Typha, Cheno-ams, Salix, and Populus. Upland plant species include Rhus and Agave. The importance of these plants to the Southern Paiute is well-documented in a number of ethnographic and archaeological studies (Bye 1973; Euler 1966; Kelly 1964; Moffit et al. 1978). Game animals represented in the faunal bone assemblage from 42Ws1629 included Sylvilagus (rabbit), Lepus (hare), Odocoileus (deer), and Ovis canadensis (bighorn sheep). Rabbits and hares most likely were obtained in the immediate vicinity. Mule deer and bighorn sheep could have come down to desert springs in winter, although this seems unlikely given the lack of adequate browse in desert landscapes. Hence, it is probable that the large game species represented in the 42Ws1629 faunal bone assemblage were procured by hunting groups deployed to upland resource areas.

The botanical data from the remaining five rockshelters (42Ws1630, 1631, 1632, 1633, and 1634) show relatively low variability in economic plant pollen species, a greater proportion of desert succulents, shrubs, and grasses, and minimal representation of upland and aquatic plant species. At 42Ws1631, the presence of Zea mays (corn) in the pollen spectrum suggests a nearby farm plot. A few upland plant species are represented in the botanical record from 42Ws1630 and 1632 (Cercocarpus, mountain mahogany, and Yucca, respectively). Collectively, the botanical data show that a broader range of plant species was utilized at 42Ws1630, 1631, and 1632 than at 42Ws1633 and 42Ws1634, the latter exhibiting a more specific focus on locally available desert plants. Minimal faunal bone was recovered from these sites, except for 42Ws1633. The substantial faunal assemblage from 42Ws1633 is noteworthy for the variety of species represented, which include Sylvilagus,

TABLE 8.4. Subsistence Activity and Seasonality of the Sites.

SITE COMPONENT	CULTURE-TEMPORAL COMPONENT	SUBSISTENCE ACTIVITY			SEASONALITY		
		Foraging	Limited Collecting and Hunting	Unknown	S	Su	F
42Ws1629							
Stratum D-Floor	Pueblo I Virgin Anasazi	x			x	x	x
Stratum C	Pueblo II Virgin Anasazi		x			x	
Strata A-B	Southern Paiute	x			x	x	x
42Ws1630	Pueblo II Virgin Anasazi		x?	x			
	Southern Paiute		x			x	
42Ws1631	Pueblo II Virgin Anasazi	x			x	x	x
	Southern Paiute		x			x	
42Ws1632	Pueblo I Virgin Anasazi	x			x	x	x
	Pueblo II Virgin Anasazi	x			x	x	x
	Southern Paiute		x			x	
42Ws1633	Pueblo II Virgin Anasazi		x			x	x
	Southern Paiute		x			x	x
42Ws1634	Southern Paiute		x			x	
42Ws1828							
Feature 1	Southern Paiute		x			x	
Feature 2	Southern Paiute			x			
Feature 3	Southern Paiute		x				
Feature 4	Southern Paiute		x				
Feature 5	Southern Paiute			x			
Feature 6	Southern Paiute			x			
Feature 7	Southern Paiute			x			

Lepus, Odocoileus, Canis spp., Bison/Bos, Aves (birds), Rodentia spp., and Reptila spp. Of these, bones of Sylvilagus, Canis, Bison, Artiodactyla (deer), and Pituophis (gopher snake) were burned, indicating cultural use. It is uncertain what proportion of the non-burned bones were dietary items for wild animals or for humans.

Very little subsistence data were recovered from the seven hearths comprising Site 42Ws1828. Zea and Allium pollen recovered from Feature 3, and a burned Calochortus bulb from Feature 4 indicate roasting of local species, as would be expected for a short-term camp.

In summary, the subsistence data from the Washington City-Green Spring project sites reveal two generally different subsistence strategies: (1) a broad-based foraging strategy that incorporated hunting and gathering of both low desert and upland species, and limited horticulture, and (2) a more specialized collecting strategy that focused primarily on locally available plant and animal species. Sites 42Ws1629 and 42Ws1632 are the best examples of the former, while the remaining sites reflect more specialized subsistence-related activities.

Subsistence change through time is readily apparent through a perusal of Table 8.4. It is clear that Virgin Anasazi groups pursued a relatively broad-based foraging strategy during the Pueblo I period, as indicated at 42Ws1629, 42Ws1631, and 42Ws1632. A shift to a more specialized collecting strategy focusing on low desert plant and animal species is apparent in the botanical and faunal record from 42Ws1629 and 42Ws1633. It would appear that if Virgin Anasazi groups in the St. George Basin were becoming more involved in agriculture along the river in the Pueblo II period, then Green Spring may have been visited only occasionally by special task groups for a few selected resources.

Marked subsistence differences are apparent for the Southern Paiute occupation of the Green Spring area. The subsistence data from 42Ws1629, 42Ws1630, and 42Ws1633 show hunting of rabbits, hares, deer, and mountain sheep, together with plants gathered from a wide-ranging catchment area. On the other hand, subsistence data from the outdoor hearth features reveal only a few locally available plant species. The scanty material culture associated with these outdoor hearths constitutes additional supporting evidence for short-term occupation. If these hearth features with their late and "Modern" dates represent post-contact Southern Paiute camps, they may reflect the dwindling Southern Paiute resource base eloquently described by Powell and Ingalls in 1874:

> They fully understand that the settlement of the country by white men is inevitable...Their hunting grounds have been spoiled, their favorite valleys are occupied by white men, and they are compelled to scatter in small bands in order to obtain subsistence (Powell and Ingalls 1874:41-42).

Technology (Material Culture)

Material culture recovered from the Washington City-Green Spring project sites includes ceramics, lithics, and historic metal and cloth artifacts. The analyses of site material culture were oriented toward identifying technological methods of resource procurement, processing, storage, and consumption, relevant to defining subsistence emphases, exchange systems, and the logistical organization of subsistence-related activities. Given the model of specialized collecting, it was expected that low variability in tool kit composition would be correlated with low variability in the botanical and faunal record from a site. Alternatively, given the model of generalized foraging, it was expected that greater variability in tool kits would be correlated with greater variation in the subsistence record. Lastly, shelter and storage facilities obviously were provided by the rockshelters, so this aspect of the model serves as a contextual parameter for the evaluation which follows.

Ceramics

Ceramics were recovered from five of the six rockshelters; only 42Ws1634 lacked pottery. Sherds recovered from the vicinity of the outdoor hearths (42Ws1828) were too few to utilize in a functional analysis. Blinman (Chapter V) has shown that functional differences exist with respect to ceramic vessel use, and that these differences are also broadly correlated with temporal and behavioral trends.

In the Washington City-Green Spring total ceramic assemblage, Virgin Series and Moapa wares of the Pueblo I period occupation are distinguished by a higher ratio of bowls to jars. These are are best represented at 42Ws1629 and 42Ws1632 and occur in small numbers at the other rockshelters. Conversely, the Pueblo II period, represented by an overall higher frequency of Shinarump wares and lowered ratio of Virgin Series and Moapa wares, is characterized by a relatively lower ratio of bowls to jars. Assuming that bowls were used primarily in the context of food consumption, the higher proportion of bowl sherds in the Pueblo I period ceramic assemblage suggests extended camping. The increased frequency of Shinarump jar sherds in the succeeding Pueblo II period might reflect a narrowing-down of the range of site activities towards more specialized use (e.g., collecting) than in the previous Pueblo I period. This interpretation of changing vessel use through time complements the subsistence data from the rockshelters, in which there appears to be a shift from a generalized foraging strategy in the Pueblo I period to more specialized collecting of local species in the Pueblo II period.

Blinman has noted that the Southern Paiute ceramic assemblage is distinguished from the Virgin Anasazi ceramic assemblage in that distinctions between bowl and jar forms are not sharply drawn. Southern Paiute jars tend to have very wide orifices and are not as smoothly finished as Anasazi bowls. This implied that functional correlates (serving vs. cooking) may not have been as strong between bowl and jar forms in Southern Paiute contexts. Inasmuch as wide orifices predominate in the Southern Paiute ceramic vessel assemblage, it is likely that the jars and bowls were used primarily for gathering and cooking rather than for storage. The scarcity of ceramic

storage jars might be attributed to Southern Paiute use of portable basketry and hide containers, which are unlikely to be represented in the archaeological record due to their portability and highly perishable nature.

Lithics

Lithic raw material variability from the Washington City-Green Spring sites indicates that there is considerable variation in terms of how the inhabitants exploited different lithic raw material resources. The combined chipped stone assemblages from the seven sites reveal that different varieties of cherts (35%) constitute the dominant utilized raw material type, followed by obsidian (26%), quartzite (16%), jasper (14%), and chalcedony (9%). Although the exact source areas from which the cryptocrystalline silicates and quartzites were collected is unknown, it is believed that the majority were obtained from the numerous gravel deposits along major stream channels and ridge slopes within the St. George Basin. Obsidian, on the other hand, appears to have derived from the Modena and Milford areas in Utah, as demonstrated by the chemical composition analysis of five obsidian samples (Appendix E). Both obsidian source areas occur 80+ kilometers north/northwest and 120+ kilometers north/northeast of the project area, respectively.

Archaeologists often use lithic source data to study many aspects of human behavior, such as site function, interaction and exchange systems, settlement patterns, and territoriality. The vast majority of these studies have been based on the distribution of one or more raw material types across a given geographical area. Luedtke (1976) originally defined two major modes of lithic raw material procurement: direct and indirect, with internal subdivisions of each. Direct procurement involved the direct removal of raw material from a source location. Indirectly procured materials were obtained through the mediation of some other individual or social group. Luedtke (1976) further refined two major types of direct procurement: casually procured material which was picked up while in the course of pursuing other activities, and deliberate procurement which involved a special trip to a source location.

With closer examination of the above modes, several underlying factors appear to have direct influence on lithic procurement strategies. These are: abundance of resources, access to resources, and anticipation of future needs. As such, with casual procurement where raw materials are widely available and access to resources is always at hand, there will be much less anticipation of future needs and planning to obtain resources. With deliberate procurement, there is an underlying need to gather resources to meet future needs. In situations where raw materials are not widely available or access is limited, future planning is necessitated and raw materials will be procured in a deliberate fashion. There is a higher degree of planned effort, and in some cases, high labor investment to obtain raw materials. Deliberate procurement strategies may be embedded in the overall subsistence system to mediate direct costs of obtaining raw material.

When exact raw material source areas are unknown, one method of assessing raw material procurement strategies is analysis of stone tool and debitage frequencies in lithic assemblages. Casual procurement would involve little planned effort in tool reduction and transportation strategies. Reduction would be designed to produce situational gear, as defined by Binford (1979). These generally consist of tools manufactured at time of need and usually require little modification, such as retouched and utilized flakes. One would expect to find at sites of casual procurement a high frequency of decortication debris and unprepared cores derived from locally available raw material sources.

Deliberate procurement is designed to meet future needs and should be used for the production of what Binford (1979) has termed personal gear. These are items which are carried around by an individual in anticipation of future conditions. Such tools generally show high degrees of modification. Archaeologically these are likely to be such items as projectile points, bifacial knives, pre-reduced blanks/preforms, or other formal tools. Deliberate procurement should be indicated by a high incidence of bifacial reduction flakes, prepared cores, broken blanks, and exhausted/depleted formal tools.

Lithic analysis of the Washington City-Green Spring assemblage implies that raw source material procurement was highly deliberate with some employment of casual collection strategies. As discussed in Chapter VI, primary and secondary core reduction activities rarely occurred at the sites and it appears that the dominant lithic production mode was secondary reduction oriented mainly toward tool maintenance and possibly limited tool production. The data suggest that most of the tools were either carried onto the sites as finished pieces or pre-reduced blanks. Furthermore, many of the formal tools, most of which are fragments, exhibit extensive edge wear from heavy use and numerous episodes of resharpening.

Casual procurement is indicated to some degree by the presence of expedient flake tools, mostly modified out of core decortication flakes, which were probably carried to the sites.

As stated earlier, combined cherts constitute 35% of the raw material selected for tool manufacture at the Washington City-Green Spring sites. Quartzite (16%), jasper (14%), and chalcedony (9%) comprise the remaining utilized non-volcanic lithic material types. It was initially felt that access to these material types was local and that numerous deposits of graded gravels containing quartzite cobbles and cryptocrystalline nodules commonly occur within the St. George Basin. At the Red Cliffs Site, a multi-component Pueblo I-Pueblo II habitation site located 10 air miles northeast of the project area, Dalley and McFadden (1985:110) imply that lithic source material procurement was a rather casual affair. Leeds Creek, which borders the site, apparently provided a source of numerous chert nodules and quartzite cobbles, although their knapping quality appears to have been very poor and brittle (Dalley and McFadden 1985). In fact, most of the expedient flake tools appear to have been manufactured out of material from Leeds Creek. Although it is not mentioned in Dalley and McFadden's report, it appears from inspection of the report's artifact photographs that formal tools were not manufactured entirely out of the raw material available at

Leeds Creek. The formal artifact photographs depict a wide variety of multi-colored cherts, jaspers, and chalcedonies, all of which appear to be of a fine-grained, vitreous quality. Overall, the implication relating to raw material availability within the St. George Basin would indicate that low-grade source material was available and was utilized for expedient tools; however, material suitable for the manufacture of formal tools was collected elsewhere.

One non-local lithic material type that was brought into the site area is obsidian. Obsidian source areas are widely scattered throughout southwestern Utah, southeastern Nevada, and northern Arizona, and considerable effort has been devoted to characterizing both sources and materials (Fred Nelson, A & G Analysis: personal communication). The value of obsidian lay in its excellent knapping qualities and its assumed prehistoric preference for manufacturing projectile points and other pressure-flaked bifaces.

The nearest known sources of obsidian occur in the Modena and Milford areas in Utah, 80+ kilometers north/northwest and 120+ kilometers north/northeast of the project area, respectively. Chemical analysis of five obsidian samples submitted from the project sites reveal that 4 derived from the Modena area and 1 from the Wild Canyon Area, Milford (Appendix E). Kane Springs Wash is another known source area which occurs 125+ kilometers to the southwest in Lincoln County, Nevada (Tucker 1985). Two other distinct obsidian material types, labeled source "A" and source "B" have also been identified in other archaeological assemblages from southwest Utah. Their exact source locations are unknown; however, the likelihood that they occur within the general southwestern corner of the state is high (Fred Nelson: personnel communication). Hence, it would appear that obsidian sources were readily available to the prehistoric inhabitants of the region within a relatively short geographical distance.

Given the relative proximity to obsidian sources, one would expect a high frequency of obsidian to occur in prehistoric assemblages in southwestern Utah. A brief review of the regional archaeological site data base indicates that obsidian was utilized by the prehistoric inhabitants, but its degree of use appears to vary with respect to site cultural affiliation and site function. At the Red Cliffs Site a multi-component Pueblo I-Pueblo II Virgin Anasazi sedentary agricultural pueblo, only five obsidian flakes (1% of the total assemblage) were noted (Dalley and McFadden 1985:128). Thompson also notes similar, low percentages from his extensive excavations of Virgin Anasazi agricultural sites at Little Creek Mountain and along Quail Creek (Dr. Richard Thompson: personal communication). In contrast, Southern Paiute sites in the St. George Basin reveal a slight to moderate increase in obsidian utilization. Tucker's 1985 excavations of Southern Paiute mixed hunting/ gathering/horticulture sites north and west of St. George showed that obsidian debitage accounted for 6.5% of the raw material types and that 27 prepared tools were manufactured from obsidian (Tucker 1985:80). While this is not a great increase in obsidian utilization, it does indicate that the later, more mobile, non-agricultural groups did have greater access to and made greater use of obsidian.

At the seven Washington City-Green Spring sites, obsidian accounts for 26% of the raw material types and at several sites the use of obsidian constitutes 42% and 47% of the assemblage. Formal pressure-flaked obsidian tools include 3 Southern Paiute projectile points, a large, corner-notched projectile point/knife base, and a graver. Obsidian debitage totals 89 pieces, out of which 19% consist of primary and secondary decortication flakes and 81% are bifacial thinning/interior flakes. No obvious use-wear was detected on any of the obsidian debitage. In all likelihood, the obsidian tools and debitage are probably associated with the late Numic occupation; however, the partially disturbed nature of the rockshelter deposits precludes conclusive confirmation.

In summary, the data from the Washington City-Green Spring sites indicate that a few obsidian nodules, collected from the Modena/Milford areas, were transported to the sites for later reduction and manufacture of pressure-flaked tools. Obsidian procurement could have involved one of several modes: making a 80 to 120+ kilometer trip to directly procure the material, or collecting the material while in the course of pursuing other activities in the neighborhood of the source areas, or exchange. Tucker (1985:120) proposes that the Southern Paiutes casually collected obsidian nodules when their settlement/subsistence round took them close to a source area. He further states that the Southern Paiutes were not carrying large quantities of obsidian back to their settlements but rather they made what they needed on or near the source (Tucker 1985:122). In sum, Tucker feels that the exploitation of obsidian sources was opportunistic and expedient (1985:122).

Such may have been the case if the seasonal round of the group or groups of Southern Paiutes who occupied the Washington City-Green Spring locality did take them near obsidian source areas. However, this procurement strategy is unlikely since it is improbable that the site inhabitants would have traveled the great distance to the Modena and Milford areas merely to procure a few pieces of obsidian. Rather, it is more reasonable to believe that the obsidian was obtained by means of trade between neighboring Southern Paiute bands.

Milling Stones

Milling stones were recovered from 42Ws1629 (TN=7), 42Ws1630 (TN=1), 42Ws1632 (TN=9), and 42Ws1633 (TN=3). These include handstones (TN=9), grinding slabs (TN=9), and miscellaneous ground pieces too small to classify as to artifact types (TN=2). The majority of the grinding implements were made of relatively fine-grained, soft sandstone derived from the Kayenta Formation (TN=12; 88%), while four (11%) were made of basalt, and two (1%) pieces are quartzite (see Chapter VI). The sandstone handstones and grinding slabs uniformly exhibit minimal formal shaping attributes. On the other hand, the basalt handstones exhibit well-defined subrectangular outlines and pronounced biconvex cross sections. The single basalt grinding slab piece (recovered from 42Ws1632) was too fragmentary to evaluate formal shaping attributes. Collectively the attributes of the sandstone handstones are comparable to those recovered from Virgin Anasazi and Southern Paiute sites reported elsewhere in southwestern Utah and northwestern Arizona (Moffit et al. 1978; Nickens and Kvamme 1981; Westfall 1985a).

The co-occurrence of handstones with unshaped sandstone grinding slabs implies seed-grinding tasks associated with wild plant procurement and processing. These tools reflect casual procurement of on-site and near-site sandstones for immediate use and their subsequent discard after use. The raw material composition, more formal shaping attributes, and lower number of basalt and quartzite handstones imply a greater investment in formal shaping efforts and a greater degree of curation of these tools for future use (cf. Westfall 1985c).

Sites 42Ws1629 and 42Ws1632 both contained milling stone assemblages with a variety of raw material types, while the collections from 42Ws1630 and 42Ws1633 are composed exclusively of sandstone. Moreover, 42Ws1629 and 42Ws1632 are further distinguished by relatively high variability in their respective flaked stone tool assemblages and subsistence records, implying procurement and processing of a broad range of resources. In contrast, 42Ws1630 and 42Ws1633 exhibited moderate variability in their flaked stone assemblages and subsistence records. These general differences are thought to reflect different subsistence emphases associated with longer-term, residential camp activities at 42Ws1629 and 42Ws1632, contrasted with short-term, specialized resource procurement and processing tasks at 42Ws1630 and 42Ws1633. The absence of milling stones at 42Ws1631 is attributed to the small area of the site that could be investigated, while the lack of such at 42Ws1634 indicates that plant resource processing simply may not have been done there. Lastly, the absence of milling stones in association with the outdoor hearth features (42Ws1828) is consistent with the presumed function of these as brief camps.

Exchange

In an area as geographically diverse as the Virgin Anasazi and Southern Paiute culture area, systems of exchange were necessary for maintaining all elements of a functioning society. These include the exchange of information, commodities, and food. It is known that the Virgin Anasazi traded in salt and turquoise with puebloan groups to the southeast (Shutler 1961), and the Southern Paiute had trade relationships with the Mohave, Hopi, Havasupai, and the northern Utes (Euler 1966, 1972; Kelly 1964; Sapir 1930; Smith 1974). While Southern Paiute exchange systems are well-known by virtue of the ethnographic record, less is known about prehistoric Virgin Anasazi exchange due to the paucity of analyzed data from excavated sites. Moreover, there are questions regarding modes of exchange; that is, did prehistoric groups directly procure exotic goods, or did goods reach these groups through serial group exchange, facilitated by group movement across different geographical areas?

It has been suggested (Chapter III) that seasonally transhumant groups are more likely to participate in inter-group and intra-group exchange than are sedentary agriculturalists, who are unlikely to have ranged very far from village settlements. As long as greater self-sufficiency is made possible by storage of agricultural surplus, wild food resources would conversely supply a lesser proportion of the dietary requirements for agriculturalists. Small hunter-gatherer bands, on the other hand, would need to obtain necessary

foods from a broad range of micro-environmental settings. Thus, if direct procurement of needed resources was neither feasible nor practical, acquisition of desired subsistence items would be facilitated by exchange systems with other groups situated in or near these other resource areas.

The material culture record from the Washington City-Green Spring project sites contains ceramics and obsidian derived from sources outside of the St. George Basin. A historic red wool cloth piece and historic rifle cartridges of Anglo-American manufacture also were recovered (see Chapters IV, V, VI, and VII). The ceramics are associated with the Virgin Anasazi and the obsidian with the Southern Paiute occupation, indicating at least two culturally and temporally distinct exchange systems. The red wool cloth piece is almost certainly associated with the Southern Paiute burial at 42Ws1633. The historic cartridges could have been deposited by either the Southern Paiutes or Anglo-Americans, although we suspect the former since no other Anglo-American material culture items were recovered from the sites.

Ceramics obtained from external sources include Moapa Gray Ware, Shinarump Gray Ware, Tsegi Orange Ware, and sherds tentatively identified as Emery Gray. Assuming that the Tusayan Gray and White Wares: Virgin Series are the "local" ceramics, the good representation of Moapa and Shinarump wares indicates intra-group exchange within the Virgin Anasazi cultural tradition. The Moapa wares may have been derived from the Mt. Trumbull, Arizona area (Weide 1978), while the Shinarump wares indicate contacts with groups to the east of present Kanab, Utah (Westfall 1985a; Wilson 1985). Inter-group exchange is demonstrated by the presence of Tsegi Orange Ware derived from the Kayenta Anasazi region in north-central Arizona, and the Emery Gray sherds indicate minor contact with the Fremont to the north-northeast of the St. George Basin.

A shift in the focus of exchange through time in the Virgin Anasazi period is manifested by a higher frequency of Moapa wares in the Pueblo I ceramic assemblage, while Shinarump wares predominate in the Pueblo II ceramic assemblage, along with the addition of Tsegi Orange Ware and Emery Gray. These show that the focus of Virgin Anasazi group exchange may have shifted from the south in the Pueblo I period towards increased exchange with groups to the east, southeast, and north-northeast in the Pueblo II period. It appears that during the Pueblo II period of population expansion, environmental and cultural conditions facilitated increased Virgin Anasazi use of the upland plateau hinterlands towards the east, and lessened contact with the lands to the west-southwest. These have implications for evaluating Virgin Anasazi group movement through time in response to possible environmental and cultural factors.

Exchange during the historic Southern Paiute occupation of the Washington City-Green Spring rockshelters appears to have operated between groups in the St. George Basin and groups to the north. This is shown by the occurrence of obsidian from the Milford and Modena, Utah areas, the presence of bison bones possibly obtained by trade, and by the similarity of the 42Ws1633 crevice burial to northern Ute burial characteristics.

A system of exchange necessarily implies intergroup co-operation and respect for territorial boundaries. Kelly (1934) has delineated Southern Paiute band territories which are roughly correlated with physiographic areas (e.g., the St. George Basin, Gunlock, Cedar, and Shivwits, to name a few). While territorial boundaries were not rigid, individual bands respected other bands' rights of usufruct and generally requested permission to use another's territory (Steward 1938). Inter-group cooperation also was fostered by a number of social events coinciding with group movements to upland forested areas in the fall (Euler 1966; Fowler and Fowler 1971, 1981; Kelly 1964). The more northerly bands, moreover, also maintained close contacts with Ute groups north of the Southern Paiute range (Kelly 1964). Hence, Southern Paiute mobility facilitated inter-group interaction, thus promoting exchange of desired goods from key resource areas.

Logistical Organization

In order to understand the function and role of the Washington City-Green Spring sites in the larger context of aboriginal cultural systems, it is necessary to define the logistical organization of the groups who occupied the sites. It was expected that the sites functioned either as residential camps in a biseasonal, transhumant settlement pattern such as that documented for the Southern Paiute, or that they were occupied on an episodic basis by specialized task groups who transported procured resources to a residential base located elsewhere. The implications of these two alternatives are that the site inhabitants participated in an annual migratory biseasonal subsistence round in the former case, while the latter type of behavior would be expected if these groups maintained year-round agricultural settlements in the St. George Basin.

The Virgin Anasazi occupation is best represented at Sites 42Ws1629, 42Ws1630, 42Ws1631, 42Ws1632, and 42Ws1633. Of these, an earlier Pueblo I occupation is represented at 42Ws1629, 42Ws1631 and 42Ws1632, and a subsequent Pueblo II occupation occurred at all of them. Subsistence and technological data indicate a broad-based foraging strategy and the use of 42Ws1629 and 42Ws1632 as residential camps during the Pueblo I period, implying a pattern of seasonal transhumance. We assume that these residential camps were occupied by family groups, perhaps organized into a small band. In contrast, the Pueblo II period occupation represents short-term use of the rockshelters by specialized task groups engaged in the procurement and processing of a few key plant and animal resources. Presumably, these resources were transported to permanent settlements located elsewhere in the near vicinity.

Different uses of the Green Spring area by the Southern Paiute are also apparent in the archaeological record. Subsistence and technological data show that 42Ws1629 and 42Ws1633 were used as residential camps, and that 42Ws1630 was used as a specialized resource processing locality during the earlier (ca. A.D. 1800-1870) historic period, while the outdoor hearths comprising Site 42Ws1828 indicate only transient occupation during post-contact times. These reconstructions of different site usages through time complement the known ethnohistoric record of the Southern Paiute occupation of southwestern Utah prior to and after settlement by Mormon colonizers (Euler 1966; Kelley 1964).

Synthesis

In summary, the investigation of six rockshelters and a series of seven outdoor hearth features in the Washington City-Green Spring project area has documented human occupation of the Green Spring area during the prehistoric Virgin Anasazi and historic Southern Paiute/Anglo-American time periods. The results of the chronological, ecological, and technological analyses have demonstrated changing site use through time. These changes are related to different subsistence and settlement strategies, reflecting different behavioral responses to environmental and cultural factors.

Indications are that the rockshelters were initially occupied by Virgin Anasazi family groups during the Pueblo I period. These groups exploited a relatively broad range of plant and animal resources, and may have followed a pattern of seasonal transhumance between the St. George Basin desert lowlands and the plateau uplands to the south. A southerly orientation is suggested by the substantial representation of Moapa graywares in the ceramic assemblage, believed to have been obtained through interaction with Virgin Anasazi groups in the region of Mt. Trumbull, Arizona and Muddy River, Nevada.

The subsequent Pueblo II period marks a shift in the use of the rockshelters from residential camps to specialized resource procurement and processing camps. The subsistence record reveals an emphasis on a few local plant and animal species. In contrast to the earlier Pueblo I period, the Pueblo II period ceramic assemblage is characterized by an increase in Shinarump wares and by the addition of Kayenta Anasazi and possibly Fremont ceramics. This phenomenon is interpreted as indicating a shift in exchange relationships from the south-southwest area to regions located further east-northeast. The reasons for this apparent shift in population interaction and implications for evaluating prehistoric population dynamics through time remain a problem in need of further study.

The archaeological record documents the presence of Southern Paiute groups in the St. George Basin as early as A.D. 1491-1589 (Tucker 1985), and Escalante reported meeting Southern Paiutes in southwestern Utah and northeastern Arizona in 1776. Radiocarbon evidence from the Washington City-Green Spring project sites indicates Southern Paiute occupation of the Green Spring area during the period A.D. 1800$\pm$ 60, and continuing past the turn of the century. As shown in the Frontispiece to this volume, the Southern Paiute of this time maintained some elements of their traditional culture while adopting some elements of the Anglo-American culture. Such may have resulted in the deposition of both Southern Paiute and Anglo- American artifacts at the Washington City-Green Spring rockshelters.

The cumulative data show that at least two sites (42Ws1629 and 42Ws1632) were used by the Southern Paiute as residential camps, one site as a specialized resource procurement and processing locality (42Ws1630), and the ridge slope for transitory camping (42Ws1828). Although absolute dates were not obtained for 42Ws1629 and 42Ws1632, they are believed to represent Southern Paiute residential camps occupied prior to the usurpation of aboriginal resource areas by the Mormon colonizers in the mid-19th Century. These

residential camps most likely were occupied by small family groups on a seasonal basis during the spring, summer, and early fall. It is probable that these groups may have moved to upland resource areas to the north during the late fall and winter, as indicated by material culture items having northerly origins (see the previous discussion on Exchange).

Southern Paiute occupation of the Green Spring area in the post-contact era is represented by the seven outdoor hearth features on the ridge slope below the rockshelters (42Ws1828). The lack of substantial material cultural remains and the minimal subsistence data associated with these ephemeral features indicate only very transitory camping episodes. This is consistent with the ethnohistoric record for the post-contact era in the St. George Basin, when the Southern Paiute resource base was seriously attenuated by the constraints of modern Anglo-American land-use patterns (Powell and Ingalls 1874; Euler 1966; Fowler and Fowler 1971, 1981).

REFERENCES CITED

Ahler, Stanley A.
1979 Functional Analysis of Nonobsidian Chipped Stone Artifacts: Terms, Variables, and Quantification. In Lithic Use-Wear Analysis, edited by Brian Hayden, Academic Press.

Aikens, C. Melvin
1965 Excavations in Southwest Utah. University of Utah Anthropological Papers 76. (Glen Canyon Series 27). Salt Lake City.

1966 Virgin-Kayenta Cultural Relationships. University of Utah Anthropological Papers 79. (Glen Canyon Series 29).

1970 Hogup Cave. University of Utah Anthropological Papers 93. Salt Lake City.

Anderson, D.C.
1971 Notes on Tongue River Silicified Sediments. Newsletter of the Northwest Chapter of the Iowa Archaeological Society, Vol. 19.

Baldwin, Gordon C.
1950 The Pottery of the Southern Paiute. American Antiquity 16:50-56.

Bandelier, A.F.
1966 The Southwestern Journals of Adolph F. Bandelier, 1880-1882. C.H. Lange and C.L. Riley, eds. School of American Research. University of New Mexico Press, Albuquerque.

Bardon, L. and J. Bouyssonie
1906 Outils ecailles par percussion. Revue de L'ecole d'Anthropologie de Paris 16.

Barnes, Frank C.
1965 Cartridges of the World. Gun Digest Co., Chicago.

Baumhoff, Martin A., and J.S. Byrne
1959 Desert Side-Notched Points as a Time Marker in California. University of California Archaeological Survey Reports 48, University of California, Berkeley.

Berry, Michael S.
1974 The Evans Mound: Cultural Adaptation in Southwestern Utah. Unpublished M.A. Thesis, University of Utah, Salt Lake City.

Binford, L.A.
1980 Willow Smoke and Dog's Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. American Antiquity 45 (1).

1982 The Archaeology of Place. Journal of Anthropological Archaeology 1(1). Academic Press, New York.

Bishop, Ronald L., Robert L. Rands, and George R. Holley
1982 Ceramic Compositional Analysis in Archaeolgical Perspective. In Advances in Archaeological Method and Theory 5, edited by Michael B. Schiffer, pp.275-330. Academic Press, New York.

Blinman, Eric
1985 Ceramic Vessels and Vessel Assemblages in Dolores Archaeological Program Collections. Dolores Archaeological Program Technical Reports DAP-269. First Draft submitted to U.S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Blinman, Eric, C. Dean Wilson, Robert M.R. Waterworth, Mary P. Errickson, and Linda P. Hart
1984 Additive Technologies Group Laboratory Manual. Dolores Archaeological Program Technical Reports DAP-149. Final Report submitted to the U.S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, in compliance with Contract No. 8-07-40-S0562.

Bordes, Francois
1972 A Tale of Two Caves. Harper and Row, New York.

Braun, David and Steven Plog
1982 Evolution of "Tribal" Social Networks: Theory and Prehistoric North American Evidence. American Antiquity 47:504-525.

Colton, Harold S.
1952 Pottery Types of the Arizona Strip and Adjacent Areas in Utah and Nevada. Museum of Northern Arizona Ceramic Series 1. Flagstaff.

1955 Pottery Types of the Southwest: Wares 8A, 8B, 9A, 9B, Tusayan Gray and White Ware, Little Colorado Gray and White Ware. Museum of Northern Arizona Ceramic Series 3. Flagstaff.

1958 Pottery Types of the Southwest: Wares 14, 15, 16, 17, 18. Revised Descriptions: Alameda Brown Ware, Tizon Brown Ware, Lower Colorado Buff Ware, Prescott Gray Ware, San Francisco Mt. Gray Ware. Museum of Northern Arizona Ceramic Series No. 3D. Flagstaff.

Crabtree, Donald
1972 An Introduction to Flintworking. Occasional Papers of the Idaho State University Museum 28. Pocatello.

Crabtree, D.E. and B.R. Butler
1964 Notes on Experiments in Flintknapping: Heat Treatment of Silica Materials, Tebiwa, Vol. 7.

Crabtree, D.E. and L. Davis
1968 Experimental Manufacture of Wooden Implements with Tools of Flaked Stone. Science 159.

Cronquist, Arthur, Arthur Holmgren, Noel Holmgren, and James Reveal
1972 Intermountain Flora. Vol.1. Hafner Publishing Company, Inc. N.Y.

Dalley, Gardiner F.
1980a Harrisburg Quantity Grant - HQG. Summary Report of Inspection for Cultural Resources on file at the Utah BLM Cedar City District Office, Cedar City.

1980b Silver Reef Quantity Grant. Summary Report of Inspection for Cultural Resources on file at the Utah BLM Cedar City District Office, Cedar City.

1982 State Quantity Grant U-49033. Summary Report of Inspection for Cultural Resources No. 053-248 on file at the Utah BLM Cedar City District Office, Cedar City.

1983 F. Thorley Exchange U-47389. Summary Report of Inspection for Cultural Resources No. 053-267 on file at the Utah BLM Cedar City District Office, Cedar City.

1984 Archaeological Test Excavations at the Green Spring R & PP Tract. Field notes on file at the Utah BLM Cedar City District Office, Cedar City.

Dalley, Gardiner F. and Douglas A. McFadden
1985 The Archaeology of the Red Cliffs Site. Bureau of Land Management, Utah State Office. Cultural Resource Series 17. Salt Lake City.

Davis, William E., Larry D. Agenbroad, Mark C. Bond, Gary M. Brown, E. Steve Cassells, Steven D. Emslie, Steven A. Weber, and Deborah A. Westfall
1985 Anasazi Subsistence and Settlement on White Mesa, San Juan County, Utah. University Press of America, Boston.

Dobyns, Henry F. and Robert C. Euler
1958 Tizon Brown Ware, A Descriptive Revision. In Pottery Types of the Southwest: Wares 14, 15, 16, 17, 18. Revised Description: Alameda Brown Ware, Tizon Brown Ware, Lower Colorado Buff Ware, Prescott Gray Ware, San Francisco Mt. Gray Ware, edited by Harold S. Colton. Museum of Northern Arizona Ceramic Series 3D. Flagstaff.

Dodd, Walter A., Jr.
1979 The Wear and Use of Battered Tools at Armijo Rockshelter. In Lithic Use-Wear Analysis, edited by Brian Hayden, pp. 231-242. Academic Press, New York.

1982 Final Year Excavations at the Evans Mound Site. University of Utah Anthropological Papers, No. 106. University of Utah Press, Salt Lake City.

Eddy, F.W.
1964 Metates and Manos: The Basic Corn Grinding Tools of the Southwest. Museum of New Mexico Popular Series Pamphlet 1.

Ericson, Jonathon E., Dwight W. Read, and Cheryl Burke
1972 Research Design: The Relationships between the Primary Functions and the Physical Properties of Ceramic Vessels and their Implications for the Ceramic Distributions on an Archaeological Site. Anthropology UCLA 3:84-95.

Euler, Robert C.
1964 Southern Paiute Archaeology. American Antiquity 29:379-381.

1966 Southern Paiute Ethnohistory. University of Utah Anthropological Papers 78. Salt Lake City.

1982 Ceramic Patterns of the Hakataya Tradition. In Southwestern Ceramics: A Comparative Review, edited by Albert H. Schroeder. The Arizona Archaeologist 15:15-69.

Euler, Robert C. and Henry F. Dobyns
1983 The Ethnoarchaeology of Pai Milling Stones. In Collected Papers in Honor of Charlie L. Steen, Jr., edited by Nancy J. Fox. Papers of the Archaeological Society of New Mexico 8. Albuquerque.

Fike, Richard E., and H. Blaine Phillips II
1984 A Nineteenth Century Ute Burial from Northeast Utah. Utah Bureau of Land Management Cultural Resource Series No. 16.

Fowler, Catherine S.
1966 Environmental Setting and Natural Resources. In "Southern Paiute Ethnohistory" by Robert C. Euler. University of Utah Anthropological Papers 78.

Fowler, Catherine S. and Don D. Fowler
1971 Notes on the History of the Southern Paiutes and Western Shoshonis. Utah Historical Quarterly 39(2):96-113.

1981 The Southern Paiute: A.D. 1400-1776. In The Protohistoric Period in the North American Southwest; A.S. 1450-1700. Davis R. Wilcox and W. Bruce Masse, eds. Arizona State University Anthropological Research Papers 24, pp. 129-162.

Fowler, Don D., David B. Madsen, and Eugene M. Hattori
1973 Prehistory of Southeastern Nevada. Desert Research Institute Publications in the Social Sciences 6. Reno and Las Vegas.

Fowler, Don D. and J.F. Matley
1978 The Palmer Collection from Southwestern Utah, 1875. University of Utah Anthropological Papers 99. (Miscellaneous Collected Papers 20).

Geib, Phil R., J. Richard Ambler, and Martha M. Callahan
1985 Archaeological Investigations Near Rainbow City, Navajo Mountain, Utah. Northern Arizona University Archaeological Report No. 576, Flagstaff.

Gifford, E.W.
1940 Culture Element Distributions 7, Apache-Pueblo. University of California Anthropological Records, 4.

Gilman, Mike
1971 An Experiment in Primitive Technology: Heat Treatment of Flint. Research Report for Anthropology 324, University of Missouri, Columbia.

Gladwin, Winifred and Harold S. Gladwin
1934 A Method for the Designation of Cultures and Their Variations. Medallion Papers 15. Gila Pueblo.

Gregory, Herbert E.
1948 Geology and Geography of Central Kane County, Utah.

Hall, H. Johnson
1978 An Archaeological Survey of the Dixie Reclamation Project. Western Anasazi Reports 1:2 (pp.79-95).

Hally, David J.
1985 Identifying Vessel Function: What the Archaeological Evidence Doesn't Tell Us. Paper presented at the 50th Annual Meeting of the Society for American Archaeology, Denver.

Heid, James L.
1982 Settlement Patterns on Little Creek Mountain, Utah. Western Anasazi Reports 3(2). Cedar City, Utah.

Heizer, R. F.
1954 Notes on the Utah Utes by Edward Palmer, 1866-1877. University of Utah Anthropological Papers 17:1-8.

Herskovitz, Robert M.
1978 Fort Bowie Material Culture. Anthropological Papers of the University of Arizona No. 31. Tucson.

Holmer, Richard N.
1978 A Mathematical Typology for Archaic Projectile Points of the Eastern Great Basin. Unpublished Ph.D dissertation, Department of Anthropology, University of Utah, Salt Lake City.

1986 Common Projectile Points of the Intermountain West. In Archaeology of the Desert West: Essays in Honor of Jesse D. Jennings, edited by Carol J. Condie and Don D. Fowler. University of Utah Anthropological Papers No. 110. University of Utah Press, Salt Lake City.

Holmes, William H.
1919 Handbook of Aboriginal American Antiquities, Part I: The Lithic Industries. Bureau of American Ethnology Bulletin No. 60.

Janetski, Joel C., and Michael J. Hall
1983 An Archaeological and Geological Assessment of Antelope Cave (NA 5507), Mohave County, Northwestern Arizona. Brigham Young University, Department of Anthropology, Technical Series 83-73.

Jennings, Jesse D.
1978 Prehistory of Utah and the Eastern Great Basin. University of Utah Anthropological Papers No. 98. Department of Anthropology, University of Utah, Salt Lake City.

Jones, Volney H.
1948 Notes of Frederick S. Dellenbaugh on the Southern Paiute from Letters of 1927 and 1928. The Masterkey 22(6):177-183.

Kelly, Isabel T.
1934 Southern Paiute Bands. American Anthropologist 36 (N.S.), pp. 548-560.

1964 Southern Paiute Ethnography. University of Utah Anthropological Papers No.69. Department of Anthropology, University of Utah, Salt Lake City.

Lange, C.H.
1959 Cochiti: A New Mexico Pueblo, Past and Present. University of Texas Press, Austin.

Lanning, F.C.
1963 Archaeology of the Rose Springs Site, INY372, University of California Publications in American Archaeology and Ethnology 49:237-336.

Lothrop, Jonathan C. and Richard Michael Gramly
1982 Pieces Esquilles from the Vail Site. Archaeology of Eastern North America, Vol. 10.

Madsen, David B.
1975 Dating Paiute-Shoshoni Expansion in the Great Basin. American Antiquity 40(1):82-86.

Madsen, Rex E.
1977 Prehistoric Ceramics of the Fremont. Museum of Northern Arizona Ceramic Series No. 6. Flagstaff, Arizona.

Marshall, Michael P.
1979 Descriptions of New Ceramic Wares and Types. In Archaeology of the Grand Canyon: the Bright Angel Site, by Douglas W. Schwartz, Michael P. Marshall, and Jane Kepp, pp. 96-104. School of American Research Press, Sante Fe.

Metcalfe, Duncan
1981 The Cockscomb Project. University of Utah Archaeological Center Reports of Investigations.

Moffit, Kathleen, Sandra Rayl, and Michael Metcalf
1978 Archaeological Investigations Along the Navajo-McCullough Transmission Line, Southern Utah and Northern Arizona. Museum of Northern Arizona, Research Paper 10.

Nickens, Paul R. and Kenneth Kvamme
1981 Archaeological Investigations at The Kanab Site, Kane County, Utah. In Excavation of Two Anasazi Sites in Southern Utah 1979-1980. Bureau of Land Management, Utah State Office Cultural Resource Series 9. Salt Lake City.

Odell, George H.
1979 A New Improved System for the Retrieval of Functional Information from Microscopic Observations of Chipped Stone Tools, In Lithic Use-Wear Analysis, edited by Brian Hayden, pp. 329-344. Academic Press, New York.

1981 The Mechanics of Use-Breakage of Stone Tools: Some Testable hypotheses. Journal of Field Archaeology 8(2).

Odell, George H. and Freida Odell-Vereecken
1980 Verifying the Reliability of Lithic Use-Wear Assessments by "Blind Tests": the Low Power Approach. Journal of Field Archaeology 7(1):87-120.

Patterson, L.W.
1976 Deer Skinning with a Bifacial Tool. Newsletter of Texas Archaeological Society 20:8-10.

Plog, Fred
1984 Exchange, Tribes, and Alliances: The Northern Southwest. American Archaeology 4(3):217-223.

Powell, John Wesley and G.W. Ingalls
1874 Report on the Condition of the Ute Indians of Utah: the Pai-Utes of Utah, Northern Arizona, Southern Nevada, and Southeastern California; the Go-si Utes of Utah and Nevada; the Northwestern Shoshones of Idaho and Utah; and the Western Shoshones of Nevada. Report on the Commission of Indian Affairs for 1873, pp. 41-46. Washington D.C.

Powell, Shirley
1983 Mobility and Adaptation: The Anasazi of Black Mesa, Arizona. Southern Illinois University Press, Carbondale and Edwardsville.

Purdy, B.A. and H.K. Brooks
1971 Thermal Alteration of Silica Materials: An Archaeological Approach. Science 173:322-325.

Rozen, Kenneth
1979 Lithic Analysis and Interpretation. In "The AEFCO Project (Volume II): Dos Condado to Apache Survey and Data Recovery of Archaeological Resources," by Deborah A. Westfall, Kenneth Rozen, and Howard Davidson, pp. 209321. Arizona State Museum Archaeological Series 144.

Rudy, Jack R.
1954 Pine Park Shelter, Washington County, Utah. University of Utah Anthropological Papers 18.

Rudy, Jack R. and Robert D. Stirland
1950 An Archaeological Reconnaissance in Washington County, Utah. University of Utah Anthropological Papers 9.

Schwartz, Douglas W., Richard C. Chapman, and Jane Kepp
1980 Archaeology of the Grand Canyon: Unkar Delta. School of American Research Press, Sante Fe.

Schwartz, Douglas W., Jane Kepp, and Richard C. Chapman
1981 Archaeology of the Grand Canyon: The Walhalla Plateau. School of American Research Press, Santa Fe.

Semenov, S.A.
1964 Prehistoric Technology. Adams and Dart, Bath.

Shapiro, Gary
1984 Ceramic Vessels, Site Permanence, and Group Size: A Mississippian Example. American Antiquity 49:696-712.

Shepard, Anna O.
1965 Ceramics for the Archaeologist (1980 reprinting). Carnegie Institution of Washington Publication 609.

Shutler, Richard, Jr.
1961 Lost City: Pueblo Grande de Nevada. Nevada State Museum Anthropological Papers 5.

Shutler, Richard, Mary Elizabeth Shutler, and James S. Griffith
1960 Stuart Rockshelter, a Stratified Site in Southern Nevada. Nevada State Museum Anthropological Papers 3. Carson City.

Simpson, R.D.
1952 "The Hopi Indians - 8." The Masterkey 26:179-191.

Smith, Anne M.
1974 Ethnography of the Northern Utes. Papers in Anthropology No. 17. University of New Mexico Press, Albuquerque.

Smith, Marion F., Jr.
1985 Toward an Economic Interpretation of Ceramics: Relating Vessel Size and Shape to Use. In Decoding Prehistoric Ceramics, edited by Ben A. Nelson, pp. 254-309. Southern Illinois University Press, Carbondale.

Steward, Julian H.
1938 Basin-Plateau Aboriginal Sociopolitical Groups. Smithsonian Institution Bureau of American Ethnology Bulletin 120.

Stewart, Omer C.
1942 Culture Element Distributions: XVIII. Ute-Southern Paiute. University of California, Anthropological Records 6(4):231-355. Berkeley.

Stokes, W.H.
1977 Subdivisions of the Major Physiographic Provinces in Utah. Utah Geology 4(1).

Sweeney, Catherine L. and Robert C. Euler
1963 Southern Paiute Archaeology in the Glen Canyon Drainage: A Preliminary Report. Nevada State Museum Anthropological Papers 9.

Thomas, David Hurst
1981 How to Classify the Projectile Points from Monitor Valley, Nevada. Journal of California and Great Basin Anthropology 3(1):7-43.

Thompson, Richard H.
1978 An Intensive Archaeological Survey of Lands subject to impact by the projected La Verkin Springs Project in Washington County, Utah. Western Anasazi Reports 1(2) pp. 97-127.

Thompson, Richard A. and Georgia Beth Thompson
1978 An Archaeological Survey of the Eastern End of the Warner Valley, Washington County, Utah. Western Anasazi Report 1(2) pp. 129-142.

1982 The Prehistory and Environment of Southwest Utah. Unpublished manuscript, Intersearch, Cedar City, Utah.

Tixier, Jacques
1974 Glossary for the Description of Stone Tools. Special Publication No. 1. Newsletter of Lithic Technology. Laboratory of Anthropology, Washington State University, Pullman.

Tringham, Ruth, Glenn Cooper, George Odell, Barbara Voytek, and Ann Whitman
1974 Experimentation in the Formation of Edge Damage: A New Approach to Lithic Analysis. Journal of Field Archaeology 1(2):171-196.

Tucker, Gordon C., Jr.
1985 Results of Archaeological Excavations in Washington, County, Utah: The Intermountain Power Project ± 500 KV DC Intermountain-Adelanto Line 1 (Revised), Utah Section-Tobin Division. Nickens and Associates, Montrose, Colorado.

Vinson, Carlos
1968 Collecting Shotshells. In Gun Digest, 22nd edition, pp. 91-97. Follett Publishing Co., Chicago.

Warren, A.H.
1980 Descriptions of Temper Types Identified in Ceramics from Unkar Delta. In Archaeology of the Grand Canyon: Unkar Delta, by Douglas W. Schwartz, Richard C. Chapman, and Jane Kepp, pp. 345-353. School of American Research Press, Santa Fe.

Weide, David L.
1978 Temper Analysis of Southern Nevada Prehistoric Ceramics: A Test Case of X-Ray Diffraction. Western Anasazi Reports 1(3).

Westfall, Deborah A.
1985a Archaeological Test Excavations at the EFN Vermilion Cliffs Project, Kane County, Utah. Abajo Archaeology, Bluff, Utah. Report on file at the Utah BLM, Cedar City District Office.

1985b An Archaeological Survey of the Energy Fuels Nuclear, Inc. Pinenut Project on Water Canyon Point, Mohave County, Arizona. Abajo Archaeology, Bluff, Utah. Report on file at the Arizona BLM, Arizona Strip District Office, St. George, Utah.

1985c Variability in Mano and Metate Assemblages: A Model for White Mesa. In Anasazi Subsistence and Settlement on White Mesa, San Juan County, Utah by William E. Davis. University Press of America, Lanham, Maryland.

Wheeler, Richard
1965 Edge-Abraded Flakes, Blades, and Cores in the Puebloan Tool Assemblage. Memoirs of the Society for American Archaeology 19.

Wilson, Dean,
1985 Analysis of Ceramics Recovered During the Vermilion Cliffs Project. In Archaeological Test Excavations at the Energy Fuels Nuclear, Inc. Vermilion Cliffs Project, Kane County, Utah, by Deborah A. Westfall, pp. 114-132. Report prepared for Energy Fuels Nuclear, Inc. Denver, Colorado, by Abajo Archaeology, Bluff, Utah.

Wise, Karen E.
1986 Prehistoric Settlement Patterns and Site Plans on Little Creek Mountain and the Western Anasazi Region. Western Anasazi Reports 3(3):273-399.

APPENDIX A

POLLEN, VEGETAL MATERIAL, AND FLOTATION ANALYSIS

by

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POLLEN

Introduction

The Washington City-Green Spring Archaeological Project involved the excavation of six rockshelters and several outdoor hearth features near Washington City, Utah. The purpose of the excavation was to describe the archaeological materials, determine the cultural affinities of the prehistoric occupants, and establish the time during which they occupied the sites. As part of these studies it was also deemed important to document any evidence of prehistoric lifestyle such as diet and the nature of the environment within which the prehistoric people lived. Toward this end both biotic remains and sediments were recovered by the archaeologists from the fill of these sites for subsequent analysis. It is these materials which are the subject of this report.

Modern Environment

The modern environment is warm and dry and the landscape is occupied by a plant community of taxa adapted to xeric environments. These plants include creosotebush (Larrea tridentata), blackbrush (Coleogyne ramosissima), bursage (Franseria dumosa), range ratany (Krameria paryifolia), little rabbitbrush (Chrysothamnus viscidiflorus), Mormon tea (Ephedra nevadensis), mesquite (Prosopis spp.), and cacti (Opuntia and Echinocereus spp.). However, a very different plant community occurs near Green Spring where permanent moisture permits the growth of emergent aquatic plants and riparian trees and shrubs including tamarisk and cottonwood.

Pollen Studies

Sediment samples for analysis include two modern soil surfaces as well as 19 samples from prehistoric levels within the sites (Table A.1). The samples, each consisting of approximately 150 ml of sediments, were submitted to standard HF-Acetolysis extraction procedures for pollen, including an initial gravimetric separation of organic and inorganic materials (Gray 1965). The samples were also spiked with tablets of exotic modern spores to check for pollen abundance and laboratory chemical corrosion of pollen. The pollen-rich residues were prepared for microscopic examination and the pollen was identified and counted utilizing magnification of 430X and 1000X. An attempt was made to obtain a count of approximately 200 grains from each sample (Table A.2).

TABLE A.1. Provenience of Pollen and Macrofloral Samples Collected from the Washington City-Green Spring Sites.

Site No.	Sample No.	Provenience
(Modern)	P-1	Modern Surface sample from ridge slope.
	P-2	Modern Surface Sample from Green Spring perimeter
42Ws1629	P-92	85N, 128E, Level 2 (Stratum B)
	P-94	85N, 128E, Level 3 (Stratum C)
	P-96	85N, 128E, Level 4 (Stratum D)
	P-101	85N, 128E, Floor of shelter
	F-93	85N, 128E, Level 2 (Stratum B)
	F-95	85N, 128E, Level 3 (Stratum C)
	F-98	85N, 128E, Level 4 (Stratum D)
	M-86	83N, 127E, Level 2 (Stratum B)
42Ws1630	P-49	Feature 1 (roasting pit) 74N, 112E, Stratum A
	P-50	Feature 1 (roasting pit) 74N, 112E, Stratum B
	P-51	Feature 1 (roasting pit) 74N, 112E, Stratum C
	F-46	Feature 1 (roasting pit) 74N, 112E, Stratum A
	F-47	Feature 1 (roasting pit) 74N, 112E, Stratum B
	F-48	Feature 1 (roasting pit) 74N, 112E, Stratum C
	M-43	76N, 112E, Level 1
	M-44	76N, 112E, Level 1
	M-45	77N, 110E, Level 2
	M-55	77N, 110E, Level 2
42Ws1631	P-17	71N, 110E, Level 1
	F-18	71N, 100E, Level 1
42Ws1632	P-48	64N, 89E, Level 2
42Ws1633	P-75	46N, 48E, Level 1
	P-77	46N, 48E, Level 2
	M-60	BLM Trench, Shelter Interior, 0-50 cm
	M-61	BLM Trench, Shelter Interior, 0-50 cm
	M-62	BLM Trench, Shelter Interior, 0-50 cm
	M-63	45N, 49E, Level 1
	M-64	45N, 49E, Level 1
	M-65	45N, 49E, Level 1
	M-66	45N, 49E, Level 1
	M-67	45N, 50E, Level 1
	M-68	45N, 50E, Level 1
	M-69	45N, 50E, Level 1

Table A.1, continued.

Site No.	Sample No.	Provenience
42Ws1634	P-8	32N, 18E, Level 2 (Stratum B)
	M-7	33N, 18E, Level 1 (Stratum A)
42Ws1828	P-12	Feature 4 10N, 140E (Firehearth fill)
	P-16	Feature 1 46N, 120E (Firehearth fill)
	P-18	Feature 2 46N, 120E (Firehearth fill)
	P-25	Feature 3 40N, 126E (Roasting pit fill)
	P-71	Feature 7 BLM Test Trench (Firehearth fill)
	P-73	Feature 6 38N, 50E, (Roasting Pit)
	P-91	Feature 5 64N, 146E (Firehearth/Charcoal) (dump fill)
	F-13	Feature 4 10N, 140E
	F-15	Feature 3 40N, 126E
	F-17	Feature 1 46N, 120E
	F-19	Feature 2 46N, 120E
	F-71	Feature 7 BLM Test Trench
	F-74	Feature 6 38N, 50E
	F-90	Feature 5 64N, 146E

Key: P = Pollen
F = Flotation
M = Macrofloral

Modern sample number 1 was obtained from a south-facing ridge slope directly below the shelters while modern sample number 2 was obtained from a 10-meter diameter area encircling Green Spring. The modern samples contained abundant and well-preserved pollen from which 35 pollen taxa were identified. Wind transported pollen types predominated but some insect-transported types were also recovered (Tables A.2 and A.3). The pollen taxa were predominantly derived from the local vegetation but the proportion of types in the modern samples differed in accordance with the local vegetation of the sample areas. The ridge sample contained only 9% grass pollen while that from the spring area contained 3 times more grass pollen, reflecting the abundance of grass near the permanent water. Also the proportions of pollen derived from aquatic herbs and riparian trees were greater in the spring sample than in the ridge sample from immediately below the shelters. Juniper and pine trees were not noted by the archaeologists while excavating these sites yet the pollen of these trees does occur in the modern samples and is probably brought to the sample areas by long distance wind transport from nearby hills. In general, the pollen composition of these modern pollen samples accords well with samples from others within the region (Hevly 1968, 1979; King and Sigleo 1973; Mehringer 1967).

TABLE A.2. Washington City-Green Spring Archaeological Project Pollen Data.

SITE NO:	Modern		42Ws1629				42Ws1630			42Ws1631	42Ws1632	42Ws1633		42Ws1634	42Ws1828						
SAMPLE NO:	1	2	92	94	96	101	49	50	51	17	48	75	77	8	12	16	18	25	71	73	91
POLLEN TYPES:																					
AP - Upland Trees																					
Abies/Picea	0	0	A1	--	--	--	--	--	--	0	0	P1	--	A1	--	--	--	--	--	--	--
Pinus:Hap.	26	16	22	9	4	2	14	-	13	6	8	6	--	8	4	--	--	5	1	--	--
Pinus:Dip.	15	11	22	6	4	4	7	--	13	9	7	4	--	7	3	--	--	6	0	--	--
Pinus:1/3's	4	2	0	8	0	2	3	--	4	1	3	0	--	0	2	--	--	0	0	--	--
Juniperus	23	15	35	21	4	8	18	-	9	7	9	14	--	11	5	--	--	7	0	--	--
Quercus	1	3	7	6	5	3	0	--	6	3	3	8	--	1	0	--	--	4	0	--	--
AP - Riparian Trees																					
Alnus	0	1	0	0	0	0	0	0	0	0	1	0	--	0	0	0	0	0	0	--	--
Celtis/Ulmus	C1	1-1	C1	0	0	C1	0	--	0	P7	0	U1	--	0	0	--	--	U1	0	--	--
Fraxinus/Juglans	0	P1	J1	0	0	0	0	--	0	J1	J1	0	--	J1	0	--	--	0	0	--	--
Populus/*Salix	S1	1-1	S1	0	S1	1-1	S5	--	2-4	0	0	0	--	0	1	--	--	S1	0	--	--
NAP - Aquatic Herbs																					
CYPERACEAE	2	5	5	0	3	2	9	--	1	0	1	0	--	0	0	--	--	0	0	--	--
Juncus	0	0	0	0	0	1	0	--	0	0	0	0	--	0	0	--	--	0	0	--	--
Typha	0	1	2	0	7	0	0	--	0	0	0	0	--	1	0	--	--	0	0	--	--
NAP - Desert Succulents and Scrubs																					
*Agave/Yucca	0	0	0	0	0	A1	0	--	0	0	Y1	0	--	0	0	--	--	0	0	--	--
Ephedra	12	13	11	5	9	15	11	--	7	3	8	17	--	6	5	--	--	6	6	--	--
*Larrea	1	0	0	0	0	0	0	--	0	0	0	0	--	0	0	--	--	0	0	--	--
*Mimosa/Acacia	0	5	0	0	0	1	0	--	0	0	0	3	--	1	5	--	--	0	0	--	--
*Opuntia	1	1	3	0	0	1	0	--	0	3	2	0	--	6	0	--	--	0	0	--	--
*Prosopis	1	0	1	1	0	1	0	--	0	0	2	0	--	0	0	--	--	0	0	--	--
*Rhamn. cf. Condalia	0	0	0	0	0	1	0	--	0	0	0	0	--	0	0	--	--	0	0	--	--
*Rhus	2	1	2	3	3	0	0	--	0	0	0	0	--	0	0	--	--	0	0	--	--
*Rose. cf. Coleogyne	1	0	0	0	3	0	0	--	0	0	0	0	--	1	0	--	--	0	0	--	--
NAP - Mixed Herbs & Shrubs																					
*APIACEAE (=UMBELLIFERAE)	1	1	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	0	0	--	--
*ASTERACEAE (=COMPOSITAE)																					
Artemisia	6	8	4	5	3	3	4	--	5	10	5	34	--	15	5	--	--	14	14	--	--
Ambrosia type	38	71	19	42	32	34	21	--	19	12	20	34	--	66	12	--	--	15	114	--	--
*Aster type	14	30	14	28	36	42	11	--	4	3	15	7	--	9	12	--	--	21	2	--	--
*LIGULIFLORAE	2	0	1	1	12	1	0	--	0	0	3	0	--	1	0	--	--	0	0	--	--
*BRASSICACEAE	1	3	4	5	0	0	5	--	0	0	0	0	--	2	0	--	--	0	0	--	--
"Cheno-Ams"	23	70	31	39	65	47	62	--	0	21	95	42	--	65	40	--	--	55	0	--	--
*Kallestromia	0	0	0	0	0	1	0	--	0	0	0	0	--	0	0	--	--	0	0	--	--
*LILIACEAE cf. Allium	0	4	0	0	0	1	0	--	0	3	0	4	--	0	2	--	--	8	0	--	--
*MALVACEAE	0	1	1	0	3	0	0	--	0	0	0	0	--	0	0	--	--	0	0	--	--
*NYCTAGINACEAE	1	0	1	0	0	1	5	--	3	0	1	0	--	0	0	--	--	0	1	--	--
*ONAGRACEAE	0	0	0	0	0	1	0	--	0	0	0	0	--	0	0	--	--	0	0	--	--
Plantago	0	3	0	0	0	1	0	--	0	0	2	0	--	0	0	--	--	0	0	--	--
POACEAE (=GRAMINEAE)	19	105	37	16	25	29	19	--	14	27	15	32	--	12	28	--	--	28	35	--	--
Zea	0	0	0	0	0	0	0	--	0	4	0	0	--	0	0	--	--	2	0	--	--
*POLEMONIACEAE	0	0	0	0	0	1	0	--	0	0	1	0	--	0	0	--	--	0	0	--	--
*POLYGONACEAE																					
*cf. Eriogonum	1	1	2	3	0	3	0	--	0	0	1	0	--	0	0	--	--	0	0	--	--
*SOLANACEAE-SCROPHULARIACEAE	0	0	0	0	0	0	0	0	0	0	1	0	--	0	0	0	0	0	0	--	--
Tidestromia	0	0	0	0	0	1	0	--	0	0	0	0	--	0	0	--	--	0	0	--	--
POLLEN TOTALS	195	376	228	198	219	211	194	0	104	120	205	207	--	214	124	0	0	173	173	--	--
Exotic Lycopodium Spores	52	173	61	37	132	12	98	--	50	97	19	25	--	18	46	--	--	47	95	--	--

*An asterisk indicates an insect transported pollen type.
--Dashes indicate insufficient pollen to count.

TABLE A.3. Key to Species Represented in the Pollen and Macrofloral Samples.

FAMILY	GENUS, SPECIES	COMMON NAME
AMARANTHACEAE	*Amaranthus* sp.	AMARANTH FAMILY
	Tidestromia sp.	Pigweed
AMARYLLIDACEAE		AMARYLLIS FAMILY
	Agave sp.	Agave, mescal
ANACARDIACEAE		CASHEW FAMILY
	Rhus sp.	Sumac
BORAGINACEAE		BORAGE FAMILY
BRASSICACEAE		MUSTARD FAMILY
CACTACEAE		CACTUS FAMILY
	Echinocereus sp.	Hedgehog cactus
	Opuntia sp.	Prickly-pear cactus
CHENOPODIACEAE		GOOSEFOOT FAMILY
	Atriplex sp.	Saltbush
	Chenopodium sp.	Goosefoot
COMPOSITAE		SUNFLOWER FAMILY
	Ambrosia sp.	Ragweed
	Artemisia sp.	Sagebrush
	ASTERACEAE	Aster Sub-family
	Chrysothamnus sp.	Rabbitbrush
	Dicoria sp.	
CUPRESSACEAE		CYPRESS FAMILY
	Juniperus sp.	Juniper
CYPERACEAE		SEDGE FAMILY
EPHEDRACEAE		JOINT-FIR FAMILY
	Ephedra sp.	Mormon tea, Brigham tea
EUPHORBIACEAE		SPURGE FAMILY
FAGACEAE		BEECH FAMILY
	Quercus sp.	Oak
GRAMINEAE		GRASS FAMILY
	Aristida purpurea	3-awn grass
	Phragmites australis	Reed
	Stipa speciosa	Needle grass

TABLE A.3, continued.

FAMILY	GENUS/SPECIES	COMMON NAME
HYDROPHYLLACEAE		WATER-LEAF FAMILY
JUGLANDACEAE		WALNUT FAMILY
	Juglans sp.	Walnut
JUNCACEAE		RUSH FAMILY
	Juncus sp.	Rush
LABIATAE		MINT FAMILY
LEGUMINOSAE		PEA FAMILY
	Krameria sp.	Range ratany
	Mimosa sp.	"Wait-a-bit"
	Prosopis sp.	Mesquite
LILIACEAE		LILY FAMILY
	Allium sp.	Onion
	Calochortus	Mariposa or sego-lily
	Yucca sp.	Yucca
MALVACEAE		MALLOW FAMILY
NYCTAGINACEAE		FOUR O'CLOCK FAMILY
OLEACEAE		OLIVE FAMILY
	Fraxinus sp.	Ash
ONAGRACEAE		EVENING-PRIMROSE FAMILY
PINACACEAE		PINE FAMILY
	Abies sp.	Fir
	Picea sp.	Spruce
	Pinus sp.	Pine
PLANTAGINACEAE		PLANTAIN FAMILY
	Plantago sp.	Plantain
POACEAE		BLUEGRASS SUB-FAMILY
	Zea mays	Corn
POLEMONIACEAE		PHLOX FAMILY
POLYGONACEAE		BUCKWHEAT FAMILY
RHAMNACEAE		BUCKTHORN FAMILY

TABLE A.3, continued.

FAMILY	GENUS, SPECIES	COMMON NAME
ROSACACEAE		ROSE FAMILY
	Cercocarpus sp.	Mountain mahogany
SALICACEAE		WILLOW FAMILY
	Populus sp.	Cottonwood, Aspen
	Salix sp.	Willow
SOLANACEAE		NIGHTSHADE FAMILY
TYPHACEAE		CATTAIL FAMILY
	Typha sp.	Cattail
ULMACACEAE		ELM FAMILY
	Celtis sp.	Hackberry
	Ulmus sp.	Elm
ZYGOPHYLLACEAE		CALTROP FAMILY
	Kallestromia sp.	(cf. Desert poppy)
	Larrea sp.	Creosotebush

In contrast, the prehistoric samples contained less pollen which was more poorly preserved than that of the modern samples; however, a greater diversity of pollen types (n=45) was recovered. The prehistoric samples were predominantly composed of wind-transported pollen but contained an even greater diversity of insect-transported pollen types than the modern samples (10 pollen types, 9 of them insect-transported, occured exclusively within the shelter samples). Insect-transported pollen is not normally abundant within shelters and caves unless transported there by solitary bees provisioning nests, or by man or rodents (such as packrats) utilizing pollen-bearing plant materials. No evidence of solitary bee activity was detected but certainly prehistoric man utilized these shelters. Packrats were also present and their middens were apparently utilized by man as fuel as, at least in one instance, burned feces of this animal were found in sample 93 of 42Ws1629.

The proportions of wind-transported pollen types of the prehistoric samples varied greatly and in some instances the proportions of Cheno- Ams, various types of Asteraceae, and Poaceae exceeded the proportions found in modern samples. One pollen type, corn (Zea), was found exclusively in the prehistoric samples. Evidence of the prehistoric human utilization of Cheno-Ams, Asteraceae and Poaceae was noted in the flotation and vegetal samples (see below) so this variation was anticipated. In general, the types and proportions of pollen taxa are similar to those observed at present, suggesting that the prehistoric environment was similar to that observed today.

FLOTATION SAMPLES AND MACROSCOPIC VEGETAL REMAINS

Introduction

Fourteen flotation samples, averaging 2000 ml in volume, were recovered from 5 rockshelters (Figure A.1). The volume of each of the dry samples was determined in a large graduated cylinder and recorded. Water was added to separate the organic and inorganic fractions. The floating organic materials were recovered by pouring the water containing these materials through a graded series of screens. The coarser screens retained larger sized organic materials such as charcoal while the smaller screens retained even small items such as mustard seed, insect fragments, and minute land snails. The organic materials were weighed. While averaging about 50 grams for each approximate 2-liter volume, the amount of organic material actually varied greatly from sample to sample (Figure A.1). Both plant and animal remains were recovered and are discussed below.

Plant Remains

Two major types of plant materials were recovered: charcoal and the mostly uncharred fragments of the vegetative and reproductive parts of a variety of plants including trees, shrubs, grasses and forbs. The general composition of charcoal recovered during flotation was determined by microscopic examination of 25 pieces from each sample. The proportion of major categories such as soft woods (Gymnosperms, including both pine and juniper) and hard wood types (Angiosperms, including both monocots and dicots) was determined (Figure A.1). Most of the wood burned by the prehistoric peoples consisted of hard woods, ring porous and diffuse porous types predominating. These types could easily have been recovered from the shrubs occurring locally. However, in Sites 1630 and 1629 charcoal of both monocots and soft woods was recovered as well. The charred monocots probably represent portions of yucca or century plant and could easily have been recovered from the local vegetation. The soft wood types recovered from these two sites include both juniper and pine trees which were reported by the archaeologists to be locally absent but probably present on nearby slopes. It would appear that both pinyon pine and juniper grew close enough to these archaeological sites in the past that their wood could be conveniently gathered for firewood.

Remains of other plant parts recovered during flotation were scarce but include materials derived from 17 taxa all of which occur in the local desert environment (Table A.4). Of these materials, only the spine clusters of Echinocerus (hedgehog cactus) and Opuntia (prickly pear), leaves of Cercocarpus (mountain mahogany), and the bulbs of Calochortus (mariposa or sego lily) were burned. The cacti and mariposa lily are edible and the fragments recovered by flotation from these sites probably represent discarded, inedible portions of dietary items used by the prehistoric inhabitants.

In addition to the flotation analysis, sixteen samples of macroscopic vegetal materials were also recovered from four shelters: 1629, 1630, 1633, and 1634 during excavation (Table A.5). Sample numbers 63 to 69 from 1633 were derived from a single mass of vegetal materials including juniper bark and entire grass plants (Phragmites, Aristida and Stipa). Additional plant

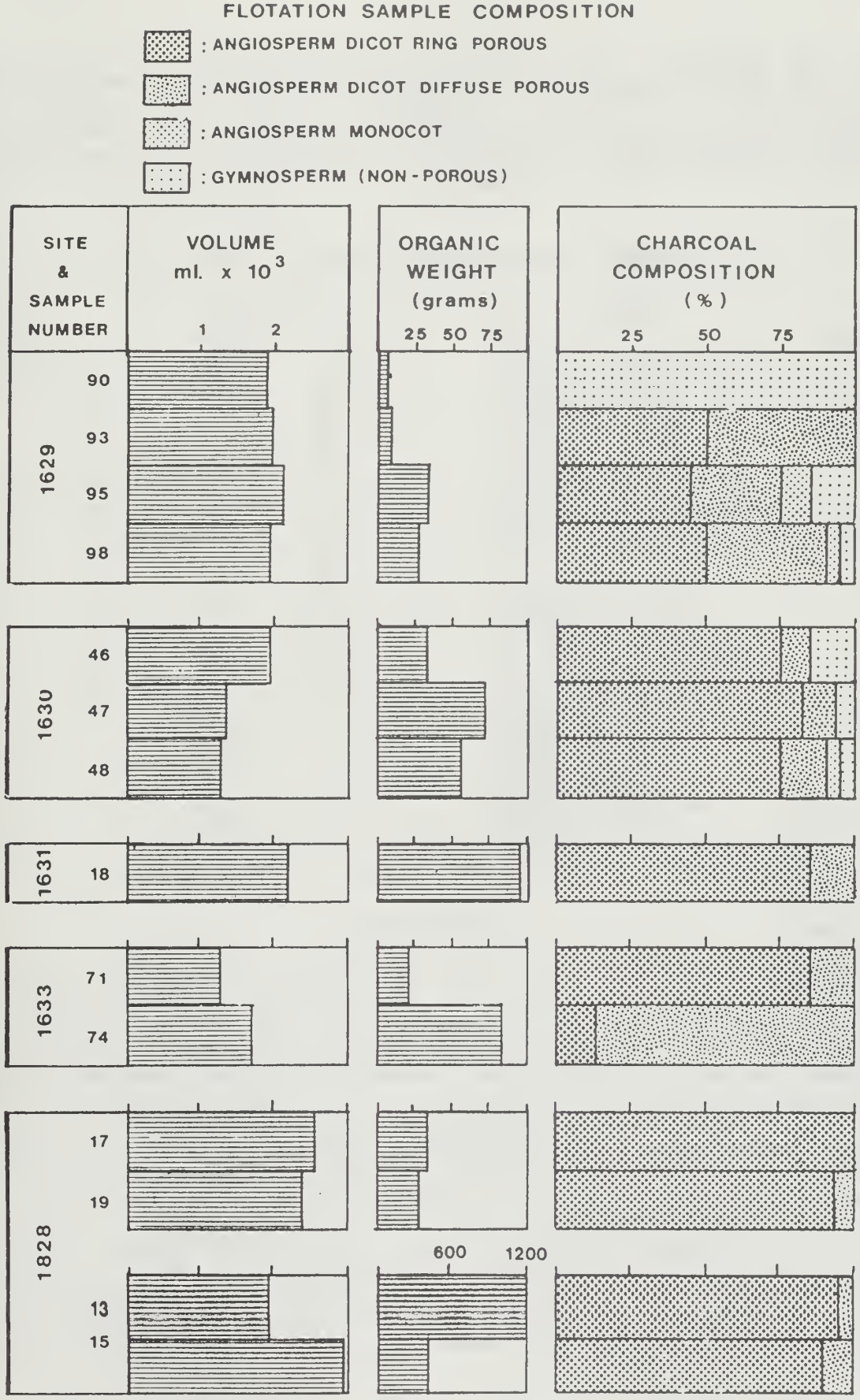
FLOTATION SAMPLE COMPOSITION
: ANGIOSPERM DICOT RING POROUS
: ANGIOSPERM DICOT DIFFUSE POROUS
: ANGIOSPERM MONOCOT
: GYMNOSPERM (NON-POROUS)
SITE & SAMPLE NUMBER
VOLUME ml. x 10^3
1
2
ORGANIC WEIGHT (grams)
25 50 75
CHARCOAL COMPOSITION (%)
25 50 75
1629
90
93
95
98
1630
46
47
48
1631
18
1633
71
74
1828
17
19
13
15
600
1200

FIGURE A.1

TABLE A.4. Taxa and Condition of Identifiable Plant Material from 14 Flotation Samples.

	42Ws1629			42Ws1630 (Roasting Pit)			42Ws1631	42Ws1828						
								F-4	F-2	F-1	F-3	F-7	F-6	F-5
	93	95	98	46	47	48	18	13	15	17	19	71	74	90
BRASSICACEAE												s?		s
ASTERACEAE			a					a			a	a	a	a
POACEAE			c	c,r,w				w			w			w,g
CUPRESSECEAE	t		t											
NYCTAGINACEAE	s													
Echinocereus	X													
Dicoria	a													
LEGUMINOSAE			s									l		s
BORAGINACEAE			n											
LABIATAE			s											
Cercocarpus					L									
Opuntia						X								
Larrea													l,f,t	
Calochortus								B						
Atriplex									t					
Krameria			p								p			
Unidentified					e	e		e				r		
NO PLANT REMAINS RECOVERED														

Key: a = achene
b = bulb
c = caryopsis
e = cuticle
g = glume
l = leaf
n = nutlet
p = capsule
r = root
s = seed
t = twig
w = awn
x = cactus spines

Capital letters indicate burned or charred material.

materials recovered from this site include the seed of Opuntia, and roots, bark and stems of rabbitbrush (Chrysothamnus). Pods and seeds of the legume family (Krameria ? or ratany and Prosopis or mesquite) are present in both the macroscopic vegetal remains and in the flotation samples. Several legumes, including mesquite, were used by modern Indian groups for food and were probably so used in the past.

TABLE A.5. Vegetal Identification of 16 Macrofloral Samples.

Site No.	Sample No.	Identification
42Ws1629	86	Unidentified seed pod
42Ws1630	43	Diptran pupal case
	44	1 EUPHORBIACEAE seed coat
		2 Opuntia seeds
	45	Stipa speciosa?
	55	1 EUPHORBIACEAE seed
42Ws1633	60	Juniperus bark (charred)
	61	Chrysothamnus nauseosus twig concentration, bark, rootstock
	62	Krameria capsule
	63	Phragmites australis, cut
	64	A) Aristida purpurea
		B) Stipa speciosa
	65	Juniperus bark, cut and pounded
	66	Juniperus, pounded
		2 Opuntia seeds
	67	Stipa speciosa
	68	Aristida purpurea
	69	Juniperus bark
42Ws1634	7	5 Prosopis juliflora seeds

Animal Remains

Animal remains were recovered in the course of flotation of materials from four shelters. These include one land snail (Pupoides hordaceus), the feces of mice and pack rats, several disarticulated skeletal parts of mice (one burned), and one reptilian vertebra, as well as numerous arthropod fragments from ants, beetles, millepedes, lepidopterans (c.f. moths), termites, flies, and spiders (Table A.6). The occurrence of burned mouse bones and millepede fragments from shelter 1629 suggests that at least some of the animals were contemporaneous with occupation. The vast majority of animal remains recovered during flotation are, however, uncharred and various developmental stages are present, suggesting that most such materials were intrusive into the fill- sediments of the shelters. They are probably related to prehistoric occupation as human dietary items but probably occur in the shelter due to the cultural accumulation of organic materials which these small animals could have used for food or shelter. The occurrence of such animal remains is not uncommon in archaeological sites and has been noted previously on and near the Colorado Plateau (Hevly 1982; Hevly and Johnson 1974).

TABLE A.6. Identification of Insect and Bone Material from 14 Flotation Samples.

Site No.	Sample No.	Identification
42Ws1629	90	2 beetles
		1 ant
		2 mouse feces
	93	Charred pack rat feces (more common than charcoal)
		Burned mouse phalange
		1 ant thorax
	95	1 millipede
		1 ant fragment
		5 mouse bones (1 burned)
	98	1 snake vertabra
		1 mouse leg bone
42Ws1630	46	1 beetle larva
		1 arthropod larva
		8 diptran pupal cases
		1 lepidoptran pupal case
		2 beetle elytra
		1 insect exoskeleton
		2 arthropod exoskeletons
		1 lepidotran larva
		1 beetle head
	47	2 millipedes
		1 diptran pupal case
		1 lepidotran pupal case
		1 beetle head
		1 arthropod leg fragment
	48	1 snail (*Pupoides hordaceus*)
		5 lepidoptran cases
		1 black widow egg case
		1 beetle jaw
		1 diptran pupal case
		1 termite larva
42Ws1633	71	2 diptron pupal cases
		1 dessicated larva (parasitoid)
		Various ant parts
		Beetle thorax
		Diptran larva case
		1 juvenile millipede
		1 mouse feces
42Ws1828	17	Beetle larva
		1 whole ant
		1 ant head
	19	1 ant
		1 diptran pupal case
		2 mouse feces

REFERENCES CITED

Gray, Jane
1965 Extraction Techniques. In Handbook of Paleontological Techniques, Kummel and Raup (eds.). W.H. Freeman and Company, San Francisco, pp. 530-587.

Hevly, Richard H.
1968 Modern Pollen Rain in Northern Arizona. Journal of the Arizona Academy of Science 5:116-127.

1979 Paleoecology of Holocene and Pleistocene Lacustrine Sediments from Zion National Park, Utah. American Institute of Biological Science Special Publication: Research in the National Parks, pp. 151-158.

1982 Analysis of Flotation Samples from the Coronado Transmission Line Corridor. Chapter 4 (pp. 225-243) In R.E. Gasser (Compiler), The Specialists' Volume: Biocultural Analysis. Museum of Northern Arizona Research Paper 23 (Coronado Series 4): 1-278.

Hevly, Richard H. and Clarence D. Johnson
1974 Insect Remains from a Prehistoric Pueblo in Arizona. Pan Pacific Entomologist 50:307-308.

King, J.E. and W.R. Sigleo
1973 Modern Pollen in the Grand Canyon. Geoscience and Man 7:73-81.

Mehringer, P.J., Jr.
1967 Pollen Analysis of the Tule Spring Area, Nevada. In H.M. Wormington and D. Ellis (eds.) Pleistocene Studies in Southern Nevada. Nevada State Museum Anthropological Papers 13, Carson City, pp. 124-200.

APPENDIX B

FAUNAL BONE ANALYSIS

by

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A total of 416 non-human bones was recovered from five Washington City-Green Spring rockshelters, of which 79 (18%) were burned. Table B.1 lists the identified species. Non-mammalian remains account for 107 NISP (number of individual specimens present) or 26% of the total recovered fauna, whereas 309 NISP non-human mammalian remains were identified, which comprise 74% of the entire fauna. The following is an account of the taxa recovered from the rockshelters. (MNI refers to the minimum number of individuals.)

CLASS REPTILIA

ORDER SQUAMATA

Suborder Serpentes

Snake remains numbered 106 NISP (25% of total NISP), of which only one was found to be burned (less than 1% of the total snakes).

Family Colubridae

cf. Masticophis sp. (Coachwhip snake)
Masticophis/Coluber (Coachwhip or Constrictor snake)
Pituophis melanoleucus (Gopher snake)

All these snakes live in the general vicinity of the project area today. No particular environmental setting is indicated by their presence.

Viperidae (= Crotalidae)

Crotalus sp. (Rattlesnake)
cf. Crotalus viridis (Western Rattlesnake)

Rattlesnakes account for 83 NISP or 78% of all snakes recovered. One test pit excavated at Site 42Ws1633 (Test Unit 45N-48E) recovered 70 NISP (one skull and 69 vertebrae; many still connected, not burned). This accounts for 90% of the rattlesnakes or 66% of the total snakes recovered. Obviously from the appearance of the vertebrae and the size gradation present, the sample represents one individual. Possibly a rodent burrow existed at the locality; the rattlesnake entered and died, or alternatively, the snake was dropped by a raptor.

Crotalus viridis, C. scutulatus (Mohave rattlesnake), and C. cerastes (Side-winder) presently live in the general region of the project area.

Suborder Sauria

Only one lizard specimen was recovered. Genus and species were indeterminate for the single specimen. A wide variety of lizards in a number of families presently live in the general area.

CLASS AVES

Bird remains number 6 NISP (1% of total 107 NISP), of which only one was burned (17% of the total bird remains). Genus and species were not determined.

CLASS MAMMALIA

Three hundred and nine (309 NISP) remains of non-human mammals were recovered (74% of the entire fauna recovered).

ORDER LAGOMORPHA

Family Leporidae

Sylvilagus sp. (Cottontail)
Lepus sp. (Jackrabbit)

Of the eleven mammalian taxa identified, leporids (rabbits and hares; 152 NISP) account for 49% of the mammals and 37% of the entire fauna. The most remains recovered of any single species is Sylvilagus (123 NISP, 39% of the mammals, 30% of the total fauna). Thirteen percent (13%) of the Sylvilagus were burned (16 NISP). Twenty-seven (27) NISP of Lepus were recovered (9% of the mammals and 7% of the total fauna). Twenty-seven percent (27%) of the Lepus were burned.

It seems apparent from the generally broken state of the bones, many of which are also burned, that Sylvilagus and Lepus were eaten by the inhabitants. This is not to say that some of the remains may not have been brought to the site via raptor or carnivore.

Presently, Sylvilagus audubonii (Desert cottontail), S. nuttallii (Mountain cottontail), Lepus californicus (Black-tailed jackrabbit), and L. townsendi (White-tailed jackrabbit) probably live in the vicinity.

ORDER RODENTIA

Family Cricetidae

Neotoma sp. (Packrat)
Reithrodontomys sp. (Harvest mouse)

Few remains of rodents were recovered from the rockshelters. Although the packrat was not identified to species, it probably belongs to *N. lepida* (Desert packrat), which presently lives in the project area. Another much larger species (*N. cinerea*; Bushy-tailed packrat) lives in the general vicinity, but usually at higher, more boreal communities.

The western harvest mouse (*R. megalotis*) presently lives in the region. Both cricetid rodents probably lived in the rockshelters, their remains recovered in the excavation recording their commensal living. Alternatively, some or all of the remains may be the product of raptors and carnivores.

Family Geomyidae

Thomomys sp. (Pocket gopher)

Just two remains (left and right mandibles) of the pocket gopher were recovered, both from the same provenience (Site 42Ws1634, 33N-18E, Level 1). Although not taken to species, the *Thomomys* probably belong to *T. bottae* (Botta's pocket gopher), which lives in the region today. These two mandibles (MNI = 1) probably represent remains from an owl pellet.

Family Heteromyidae

Dipodomys sp. (Kangaroo rat)

Three species of kangaroo rat presently live in the general region: *D. merriami*, *D. ordii* (Ord's kangaroo rat), and *D. microps* (Chisel-toothed kangaroo rat). As with the pocket gopher, the kangaroo rat probably represents owl pellet remains.

ORDER CARNIVORA

Family Mustidae

Taxidea taxus (Badger)

The badger is a common carnivore throughout the arid Southwest. The single skeletal element from 42Ws1633 may represent an animal brought to the locality by humans. No burning or cut marks were evident on the bone. Alternatively, the badger may have used a portion of the site for its home. Badgers commonly construct large burrows in soft alluvium.

Family Canidae

cf. Canis sp. (Wolves, Coyote, and Dog)
cf. C. latrans (Coyote)

Some of the canid remains were not well enough preserved or of the required skeletal element to determine whether the bones belonged to the coyote or to the domestic dog. Either species would likely be found in the area in prehistoric and historic years.

ORDER ARTIODACTYLA

Eleven (11) skeletal remains were identified to the generic level within the order Artiodactyla, although there were many unidentifiable scrap remains. Of the 11 (4% of the mammals), 8 NISP (73%) were burned.

Family Cervidae

cf. Odocoileus sp. (deer)

Presently only O. hemionus (Mule deer) lives in the vicinity of the project area. All remains were burned.

Family Bovidae

Bison/Bos (Bison or Cattle)
Ovis canadensis (Bighorn sheep)

Bighorn sheep presently live in the general region of the sites. Their remains are to be expected in archaeological context, although only a single burned element was identifiable to the genus. I suspect that the Bison/Bos remains belong to the bison, assuming that these skeletal elements predate the introduction of cattle to the Western Hemisphere. Bison apparently ranged over most of the Southwest, but were never overly abundant. It is likely that these elements were traded in or brought from a long distance.

CONCLUSION

Eighteen different taxa were identified from the excavated portions of the rockshelters. Although some of the mammals (Dipodomys, Neotoma, Reithrodontomys, Thomomys) can be accounted for by a number of non-human agencies, the lagomorphs (Sylvilagus and Lepus) and the artiodactyls (Ovis canadensis, cf. Odocoileus, and Bison/Bos) appear, for the most part, to have been utilized by the human inhabitants. Many of these bones were heavily broken and burned. Very few of the other remains were burned.

I cannot provide MNI accounts for most animals, especially those potentially used by humans. It would appear based upon the numbers provided here that very few artiodactyls were utilized (maybe one individual of each animal). In contrast, jackrabbits and especially cottontails were heavily used. Looking just at the provided data, I would suggest that leporids were the dominant meat source for the inhabitants of the site.

TABLE B.1. List of Identified Vertebrates from the Project Sites.

Bison/Bos (Bison or Cattle)
cf. Canis latrans (Coyote)
cf. Canis sp. (Wolf, Coyote or Dog)
Crotalus sp. (Rattlesnake)
cf. Crotalus viridis (Western rattlesnake)
Dipodomys sp. (Kangaroo rat)
Lepus sp. (Jackrabbit)
cf. Masticophis sp. (Coachwhip snake)
Masticophis/Coluber (Coachwhip or Constrictor snake)
Neotoma sp. (Packrat)
cf. Odocoileus sp. (Deer)
Ovis canadensis (Bighorn sheep)
Pituophis melanoleucus (Gopher snake)
Reithrodontomys sp. (Harvest mouse)
Sylvilagus sp. (Cottontail rabbit)
Taxidea taxus (Badger)
Thomomys sp. (Pocket gopher)

Table B.2 is a list of the reptile, bird, and non-human mammalian remains recovered and identified from the Washington City-Green Spring project sites. Identification is provided for all remains. The Field Number (bag number is provided first, then provenience, species identification, and skeletal element (sometimes providing whether left [L] or right [R]. If the element was burned, it is so indicated in parentheses along with the number of burned NISP, if greater than one. Numbers at the far right are the NISP of the element and species.

TABLE B.2. List of Reptile, Bird, and Non-Human Mammalian Remains.

SITE NO: 42Ws1629

FN	PROVENIENCE	IDENTIFICATION	NISP
63	83N-127E, Level 1	Scrap mammal (burned)	3
64	83N-128E, Level 1	cf. Odocoileus sp.	
		Astragalus L (burned)	1
		Sylvilagus sp.	
		Calganeum	1
		Scrap mammal (3 burned)	5
		Artiodactyla scrap	1
65	83N-129E, Level 1	Scrap mammal (burned)	1

SITE NO: 42Ws1629, continued.

FN	PROVENIENCE	IDENTIFICATION	NISP
67	84N-127E, Level 1	cf. *Odocoileus* sp.	
		3rd phalanx (burned)	1
		Scrap	4
		Sylvilagus sp.	
		Tibia fragment	1
		Femur fragment	1
		Innominate fragment (burned)	1
		Leporidae	
		Metatarsal fragment (burned)	1
		Aves humerus (burned)	1
68	84N-128E, Level 1	Scrap mammal	1
		Lepus sp.	
		Femur L fragment	1
		Innominate fragment (burned)	1
		Scapula fragment (burned)	1
		Sylvilagus sp.	
		Maxillary fragment	2
		Innominate fragment	1
		Sacrum	1
69	84N-129E, Level 1	Cervidae/Bovidae	
		Metapodial dist. epiphys.(burned)	2
		cf. *Sylvilagus*	
		Scapula fragment	1
		Scrap mammal (8 burned)	8
70	85N-127E, Level 1	*Neotoma* sp.	
		Mandible L	1
		Cervidae/Bovidae	
		2nd phalanx (burned)	1
		Sylvilagus	
		Scapula L	1
		Mandible L	1
		Innominate fragment (burned)	1
		Radius fragment (burned)	1
		Lepus sp.	
		Mandible fragment R (burned)	1
		Innominate fragment (burned)	1
		Vert.	1
71	85N-128E, Level 1	cf. *Lepus* sp.	
		Ulna fragment (burned)	1
		Tibia fragment (burned)	1
		Scrap (2 burned)	2
72	85N-129E, Level 1	*Sylvilagus* sp.	
		Humerus fragment (burned)	1
		Scrap mammal (2 burned)	2

SITE NO: 42Ws1629, continued.

FN	PROVENIENCE	IDENTIFICATION	NISP
73	85N-128E, Level 1	cf. *Lepus* sp. mandible (burned)	1
		Rodentia	1
74	83N-127E, Level 2	*Sylvilagus* sp.	
		Mandible fragment (1 burned)	2
		Scrap	7
75	83N-128E, Level 2	*Lepus* sp.	
		Maxillary fragment	1
		Sylvilagus sp.	
		Scapula fragment	1
76	83N-129E, Level 2	cf. *Sylvilagus* sp.	
		Tibia fragment (burned)	1
		Rodentia	
		Scrap (1 burned)	2
		Scrap (burned)	1
77	84N-127E, Level 2	cf. *Odocoileus* sp.	
		Phalanx (burned)	1
		Small mammal	
		Scrap (burned)	2
78	84N-128E, Level 2	Artiodactyla	
		Sternal rib (burned)	1
		Sylvilagus sp.	
		Femur fragment L and R	2
		Innominate fragment	1
		Vert.	1
		Humerus fragment	1
		Mandible fragment L	1
		Scrap mammal (burned)	1
		Rodentia	
		Tibia	1
79	84N-128E, Level 2	*Ovis canadensis*	
		Naviculo-Cuboid (burned)	1
80	84N-129E, Level 2	cf. *Sylvilagus* sp.	
		Vert. fragment	1
81	85N-127E, Level 2	*Sylvilagus* sp.	
		Femur fragment	1
		Maxillary	1
		Mandible fragment L	1
		Small mammal	
		Axis	1

SITE NO: 42Ws1629, continued.

FN	PROVENIENCE	IDENTIFICATION	NISP
82	85N-128E, Level 2	*Sylvilagus* sp.	
		Tibia fragment (burned)	1
		Scapula fragment (burned)	1
		Scrap mammal (burned)	1
83	85N-129E, Level 2	*Sylvilagus* sp.	
		Tibia fragment L	1
		Radius fragment	1
		Scrap mammal (burned)	1
84	86N-128E, Level 2	*Neotoma* sp.	
		Mandible L	1
		Sylvilagus sp.	
		Metatarsal	1
85	85N-128E, Level 3	Carnivora	
		Vert. fragment (burned)	1
		Scrap mammal (burned)	2
SITE NO:	42Ws1630		
54	76N-112E, Level 1	Scrap mammal	2
SITE NO:	42Ws1631		
12	71N-100E, Level 3	Scrap mammal (burned)	1
		Sylvilagus sp.	
		Tibia fragment	1
SITE NO:	42Ws1633		
19	BLM Test Trench (BLM Fea.5) 0-50cm	Aves vert.	1
		Scrap mammal (13 burned)	27
		cf. *Canis* sp.	
		Rib fragment	3
		Femur (proximal end)	1
		Humerus	1
		Radius fragment	1
		Fragment	1
		cf. *Canis latrans*	
		Humerus proximal epiphysis	1
		Artiodactyla	
		Scrap	2
		Bison/*Bos*	
		Phalanx (burned)	1
		Left astragalus	1
		Sylvilagus sp.	

SITE NO: 42Ws1633, continued.

FN	PROVENIENCE	IDENTIFICATION	NISP
19	BLM Test Trench, continued. (BLM Fea. 5) 0-50 cm	Metatarsal fragment	1
		Calcaneum fragment	1
		Tibia fragment	1
		Femur fragment	1
		Humerus fragment	1
		Scrap (2 burned)	12
		Lepus sp.	
		L. mandible	1
		Rodentia/Lagomorpha	1
21	39N-53E, Level 1	*Lepus* sp.	
		L. Scapula	1
22	44N-46E, Level 1	Aves humerus	1
		Sternum	1
		Scrap (1 burned)	2
		Sylvilagus sp.	
		Mandible L	1
		Femur R (1 burned)	2
		Scapula fragment	1
		Tibia fragment	1
		Maxillary fragment	1
		Squamosal	1
		Innominate	1
		Taxidea taxus (juvenile) R	1
		cf. *Canis*	
		Metatarsal (1 burned)	2
23	44N-46E, Level 1	cf. *Bison*/*Bos*	
		Trapezoid-magnum	1
26	44N-46E, Level 1	*Lepus* sp.	
		Premaxilla	1
		Maxillary L and R	2
27	44N-46E, Level 1	*Bison*/*Bos*	
		Femur proximal epiphysis	1
		Rib fragment	1
28	44N-47E, Level 1	*Sylvilagus* sp.	
		Tibia R	2
		Vert.	3
		Innominate	1
		Radius	1

SITE NO: 42Ws1633, continued.

FN	PROVENIENCE	IDENTIFICATION	NISP
29	44N-48E, Level 1	Artiodactyla scrap	1
		Sylvilagus sp.	
		Innominate	1
		Vertebral column	1
		Sacrum	1
		Crotalus sp. vert.	1
		Masticophis/Coluber vert.	2
30	44N-49E, Level 1	Sylvilagus sp.	
		Distal humerus	1
		Scrap	3
		Masticophis/Coluber vert.	1
31	44N-50E, Level 1	Artiodactyla scrap	1
		Leporidae	1
		Crotalus sp. vert.	1
		cf. Masticophis sp. vert.	1
		Masticophis/Coluber vert.	1
		Pituophis melanoleucus vert.	1
34	45N-46E, Level 1	Lepus sp.	
		Maxillary fragment	1
		Vert. fragment	1
		Sylvilagus sp.	
		Innominate	1
35	45N-47E, Level 1	Sylvilagus sp.	
		Tibia L and R	2
		Femur L	1
		Calcaneus	1
36	45N-48E, Level 1	Lepus sp. Maxillary fragment	1
		Scrap	1
37	45N-48E, Level 1	Sylvilagus sp. vert.	1
		Artiodactyla scrap	1
		Lepus sp. maxillary	1
		Neotoma sp. L dentary	1
		Crotalus sp. vert.	1
38	45N-49E, Level 1	Sylvilagus sp.	
		Innominate R	1
		Vert.	1
		Femur dist.	1
		Femur R (1 juvenile)	2
		Scrap	1

SITE NO: 42Ws1633, continued.

FN	PROVENIENCE	IDENTIFICATION	NISP
39	45N-49E, Level 1	cf. *Canis latrans*	
		Phalanx	1
		Dung	1
		Large mammal	
		Scrap	1
		Sylvilagus sp.	
		Maxillary	1
		Tibia fragment	1
42	46N-47E, Level 1	*Lepus* sp. humerus	1
43	46N-48E, Level 1	*Sylvilagus* sp.	
		Vert. (burned)	1
		Femur fragment	1
		Scapula fragment	1
		Neotoma sp.	
		Frontal	1
45	46N-49E, Level 1	Scrap mammal (1 burned)	4
		Neotoma sp.	
		Mandible L	1
		Small mammal	
		Scrap	2
		Sylvilagus sp.	
		Tibia fragment L and R	2
		Mandible fragment R	1
		Femur fragment L	1
		Maxillary fragment	1
		Pituophis melanoleucus	
		Vert. (1 burned)	5
		Bison/*Bos*	
		Rib fragment (burned)	1
		Artiodactyla	
		Vert. fragment (burned)	1
46	46N-50E, Level 1	Large Mammal	
		Scrap	1
48	46N-50E, Level 1	*Sylvilagus* sp.	
		Mandible fragment L	3
		Aud. bulla L	1
		Tibia fragment	1
		Radius fragment	1
		Scrap mammal	1
50	46N-51E, Level 1	Large mammal scrap	2

SITE NO: 42Ws1633, continued.

51	44N-47E, Level 2	Rodentia	
		Tibia	1
		Radius fragment	1
		Crotalus sp.	
		Vert.	1
		cf. *Masticophis* sp.	
		Vert.	1
		Dentary R	1
52	44N-48E, Level 2	Rodentia/Lagomorpha	
		Scrap	2
		Crotalus cf. *viridis*	5
53	44N-49E, Level 2	*Sylvilagus* sp.	
		Tibia fragment	1
		Femur fragment	1
		Crotalus sp. vert.	1
		cf. *Masticophis* sp. vert.	1
54	44N-50E, Level 2	*Lepus* sp.	
		Mandible	1
		Rodentia	
		Scrap	2
		cf. Iguanidae	
		Occipital	1
55	45N-47E, Level 2	*Dipodomys* sp.	
		Skull	1
		Mandible	1
		Sylvilagus sp.	
		Vert.	1
		Rodentia	
		Scrap	8
		Large mammal	1
		Crotalus sp. vert.	3
		cf. *Masticophis* sp. vert.	2
56	45N-48E, Level 2	*Crotalus* sp.	
		Skull fragment	1
		Vert.	69
		cf. *Masticophis* sp.	
		Vert.	7
		Sylvilagus sp.	
		Scapula fragment L and R	2
		Maxillary	1
		Vert.	2
		Small mammal	
		Scrap	1
		Neotoma sp.	
		Mandible L	1

SITE NO: 42Ws1633, continued.

FN	PROVENIENCE	IDENTIFICATION	NISP
57	45N-49E, Level 2	*Lepus* sp.	
		Tibia fragment	1
		Radius fragment	1

SITE NO: 42Ws1634

6	33N-18E, Level 1	*Lepus* sp.	
		Tibia dist. epiph	1
		Sylvilagus sp.	
		Metapodial	7
		Phalanx	2
		Innominate	1
		Calcaneum	1
		Tibia fragment L and R	3
		Small mammal	
		Scrap	2
		Thomomys sp.	
		Mandible L and R	2
		cf. *Reithrodontomys*	
		Mandible L	1

APPENDIX C

RADIOCARBON DATING ANALYSES

by

Beta-Analytic, Inc.
Coral Gables, Florida

Radiocarbon Dating Analyses

Nine carbonized wood samples were submitted to Beta-Analytic, Inc. of Coral Gables, Florida, for radiocarbon dating analyses (Table C.1). These dates are reported as radiocarbon years before 1950 A.D. The half-life of radiocarbon is taken as 5568 years and 95% of the activity of the National Bureau of Standards Oxalic Acid (original batch) used as the modern standard.

A number of samples showed activities that were statistically indistinguishable from those of the modern standard, and were assigned "Modern" ages. Due to the DeVries effect and the effect of the Industrial Revolution of the 1850s, radiocarbon dating of samples as young as 270 B.P. could show "Modern" dates.

TABLE C.1. Report of Radiocarbon Dating Analyses.

LAB NUMBER	SAMPLE NUMBER	PROVENIENCE	C-14 AGE YEARS BP ± 1
Beta-14341	56	42Ws1630, Feature 1	Modern
Beta-14342	19	42Ws1631, Charcoal lens	Modern
Beta-14345	10	42Ws1634, Stratum A	150 ± 50 B.P.
Beta-14346	22	42Ws1828, Feature 1	Modern
Beta-14348	23	42Ws1828, Feature 2	Modern
Beta-14347	24	42Ws1828, Feature 3	140 ± 60 B.P.
Beta-14349	20	42Ws1828, Feature 4	80 ± 60 B.P.
Beta-14343	83	42Ws1828, Feature 6	Modern
Beta-14344	82	42Ws1828, Feature 7	Modern

APPENDIX D

HUMAN SKELETAL ANALYSIS

by

Mark G. Taylor, Ph.D.
Associate Professor of Anthropology
Northern Arizona University
Flagstaff, Arizona 86011

42Ws1633 Burial 001

Human skeletal remains were recovered from scattered locations in the upper 10 cm of rockshelter fill in the western bench area of 42Ws1633. A complete inventory of the human bones is as follows:

BAG NO.	PROVENIENCE	HUMAN BONES
33	45N, 46E, Level 1	3 bone fragments (unidentified)
40	45N, 50E, Level 1	1 distal epiphysis of right radius
44	46N, 49E, Level 1	4 left ribs (large fragments)
47	46N, 50E, Level 1	1 left calcaneous
		1 left 5th metatarsal
		1 right rib fragment
49	46N, 50E, Level 1	1 left radius (complete)
58	45N, 49E, Level 2	2 fragments of left clavicle
59	45N, 50E, Level 2	1 right rib (fragment)

Age = 17

We estimate that this individual died at approximately 17 years of age. The proximal epiphysis of the left radius had completely fused with the diaphysis. The distal epiphyseal plate, however, was distinct, showing no fusion. This places the age at death at between 16 years and 19 years (Krogman 1962:33; Bass 1977:121). This estimate of 17 years is further supported by a study, reported by Ubelaker (1978:50), correlating subadult Arikara and Indian Knoll radii length with age. Epiphyseal union in the 5th metatarsal occurs at 15-16 years (Krogman 1962:32). Fusion in this bone was almost complete, again substantiating our estimate.

Sex = Male

Sex discrimination is difficult without the innominates and/or the skull. If long bones are present, sex determination can be made using absolute lengths as discriminant functions. The length of the left radius is 23.2 cm. According to Ubelaker (1978:87), this fits within the range of male radii. Based upon this length, the individual's stature can be reconstructed as 82.13 cm or approximately 5'5". This reconstructed stature is similar to the expected stature of an Indian male about 17 years old.

Pathologies = None

No evidence of any pathological condition was noted. No genetic, environmental, or cultural anomalies were seen.

Conclusions

The human skeletal remains are those of an Indian male approximately 17 years of age when he died. No cause of death could be ascertained.

The precision of any skeletal analysis increases as the number of bones analyzed increases. We are fortunate in having two bones, the complete radius and the 5th metatarsal, showing incomplete epiphyseal union. This makes our age at death estimate quite accurate. Sexing such an incomplete skeleton presents more of a problem, however. Our conclusion is based upon a few previous studies, none of which are specific for North American Indian populations, and our own experience. That we found no pathological evidence is not surprising. The particular bones we studied rarely show evidence of dietary deficiencies, chronic or acute disease, trauma, or even genetic anomalies. Obviously, a more complete skeleton would yield more information. Because the bones were in good condition, we believe that all of them are from the same individual. The location at which they were found suggests a North American Indian ancestry. The fact that most of the bones are from the left side of the body is consistent with natural decay and erosion patterns for other Southwestern human burials.

REFERENCES CITED

Bass, William M.
1971 Human Osteology: A Laboratory and Field Manual of the Human Skeleton. Missouri Archaeological Society, University of Missouri, Columbia, Missouri.

Krogman, Wilton M.
1962 The Human Skeleton in Forensic Medicine. Charles C. Thomas, Springfield, Illinois.

Trotter, Mildred and Goldine C. Gleser
1958 A Pre-Evaluation of Estimation of Stature Based on Measurements of Stature Taken During Life and of Long Bones after Death. American Journal of Physical Anthropology, Vol. 16, No. 1, pp. 79-123.

Ubelaker, Douglas
1978 Human Skeletal Remains, Excavation, Analysis, Interpretation. Aldine, Chicago.

Case # _____ Project/Site 42Ws1633 Burial # 001

P = Present A = Absent

Laboratory Photos B & W _____ Color _____
Field Photos B & W _____ Color _____

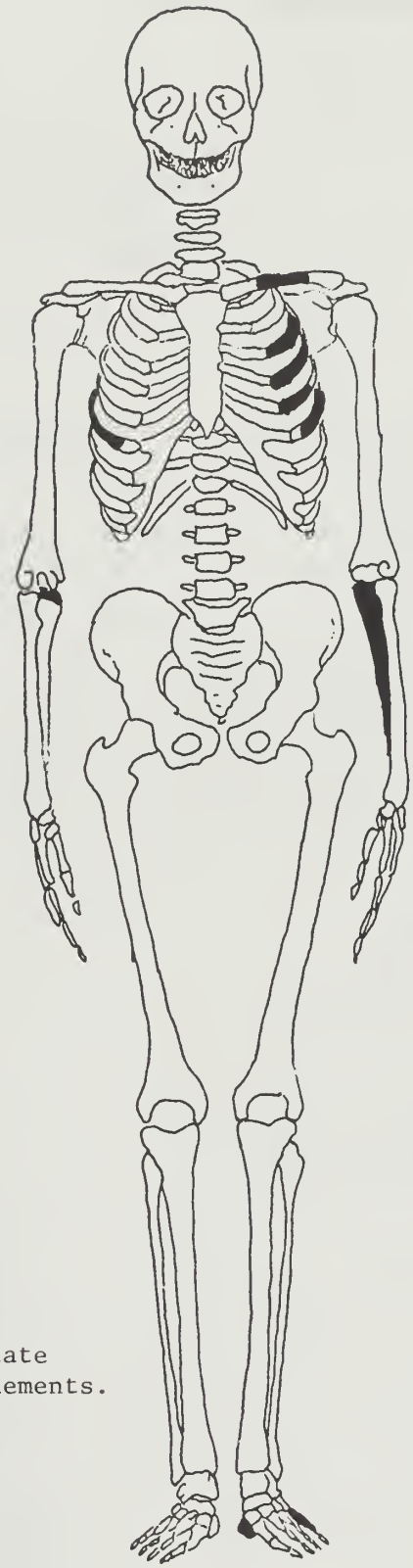
Visual Inventory Sheet	x
Skeletal Analysis Sheet	x
Skeletal Analysis Sheet (Dental)	x
Human Bone Tally	x
Burial Data	

PATHOLOGIES none

DEFORMATIONS none

ANOMALIES none

Case # _____ Project/Site 42Ws1633 Burial # 001



*Shaded portions indicate recovered skeletal elements.

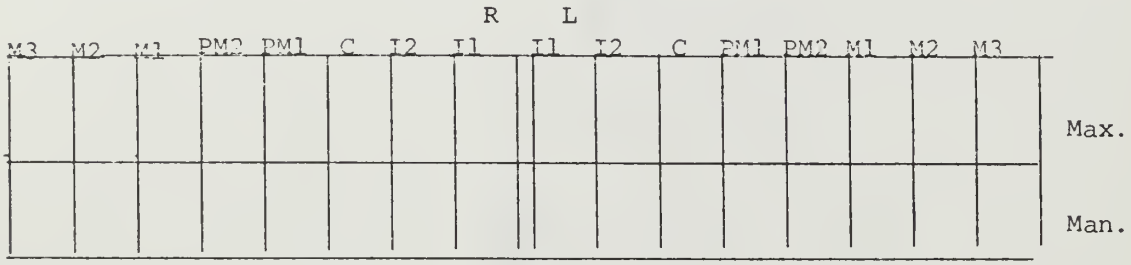
VISUAL INVENTORY

CASE# _____ Project/Site 42Ws1633 Burial # 001

SKELETAL ANALYSIS SHEET (Dental)

Dental Record:

. = Present, good condition.
A = Abcess.
C = Carious.
I = Impacted.
U = Unerupted.
* = See pathologies.
+ = Calculus.
# = Bone missing.
- = Missing antemortem.
/ = Missing postmortem.
d = Deciduous.
H = Enamel hypoplasia.



Artificial deformation, pathologies, anomalies: _____

Notes: No teeth were found.

Case # _____ Project/Site 42Ws1633 Burial # 001

SKELETAL ANALYSIS SHEET

Site Number 42WS1633 Date 3/11/86

Burial Number _____ Observer M. Taylor

Culture _____ Period/Time _____ Preservation Good

Sex M Age 17 – 12 yrs Stature (method) 82.13 cm (Trotter & Gleser)

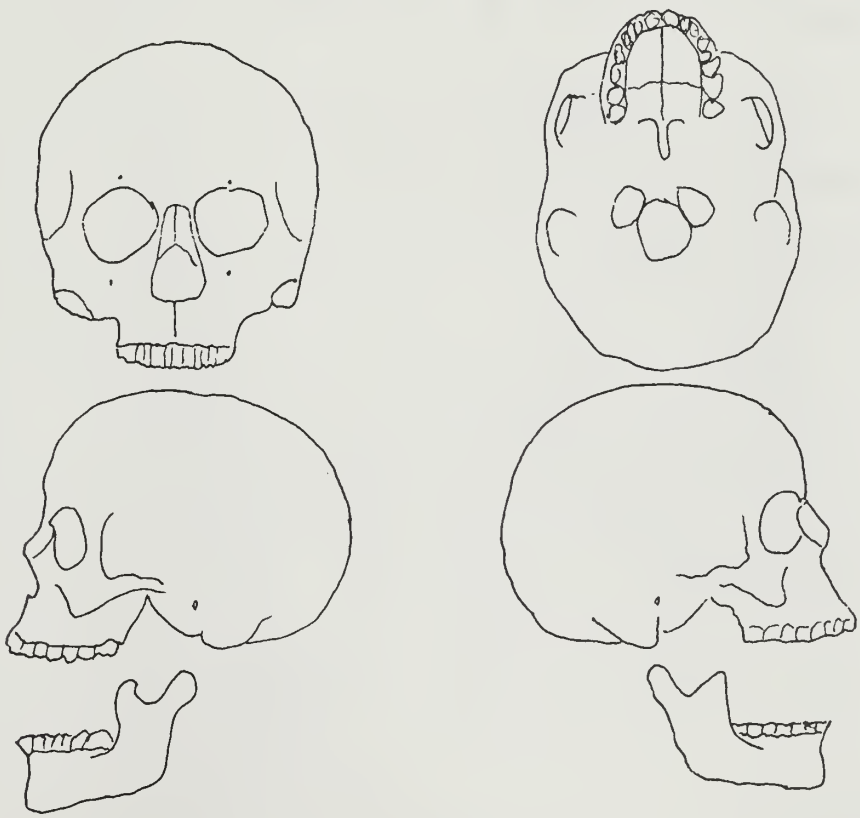
Completeness: P = Present, A = Absent, F = Fragment,
PF = Present, fragmentary

Cranium	A
Mandible	A
Hyoid	A
Sternum:	
Manubrium	A
Corpus	A
Xiphoid Process	A

Vertebrae:	
Cervical(7)	A
Thoracic(12)	A
Lumbar(5)	A
Sacrum	A
Coccyx	A

	L	R		L	R		L	R
Ossicles(3)	A		Femur	A		Carpals(8)	A	
Scapula	A		Tibia	A		Metacarpals(5)	1(5th)	A
Clavicle	PF	A	Fibula	A		Phalanges(14)	A	
Innominate	A		Humerus	A		Tarsals(7)	A	
Ribs(12)	3+	1	Radius	P	PF	Metatarsals(5)	A	
Patella	A		Ulna	A		Phalanges(14)	A	

Skull Completeness: Absent



CASE# _____ Project/Site 42Ws1633 Burial # 001

HUMAN BONE TALLY
(Number of Pieces Present)

Cranium	–	Vertebrae:	
Mandible	–	Cervical	–
Teeth (in place)	–	Thoracic	–
(loose)	–	Lumbar	–
		Indeterminate	–
Hyoid	–	Sacrum	–
		Coccyx	–
Sternum:			
Manubrium	–	Sesamoids	–
Corpus	–		
Xiphoid Process	–		
Indeterminate	–		

	L	R	Ind.
Ossicles	–	–	–
Scapulae	–	–	–
Clavicles	1	–	–
Innominates	–	–	–
Ribs	4	1	–
Patellae	–	–	–
Femora	–	–	–
Tibiae	–	–	–
Fibulae	–	–	–
Indeterminate leg bone fragments			–
Humeri	–	–	–
Radii	X	PF	–
Ulnae	–	–	–
Indeterminate arm bone fragments			–
Indeterminate long bone fragments			–
Carpals	–	–	–
Metacarpals	0	–	–
Phalanges	–	–	–
Tarsals	1	–	–
Metatarsals	1	–	–
Phalanges	–	–	–
Indeterminate hand/foot fragments			–
Indeterminate bone fragments			–

APPENDIX E

OBSIDIAN SOURCE ANALYSIS

WASHINGTON CITY-GREEN SPRING PROJECT

by

Dr. Fred Nelson
A & G Analysis
Provo, Utah

Sample Number	Provenience	Rb ppm	Sr ppm	Y ppm	Zr ppm	Nb ppm	MnO %	Fe_2O_3 %	TiO_2 %	Ba ppm	Na_2O %	Obsidian Source
					42Ws1629							
2146 Bag 4	84N/129E L. 1	200.8	79.2	40.8	163.0	29.1	.042	.97	.136	478.0	3.24	14
					42Ws1630							
2147 Bag 3	75N/112E F. 1	194.6	78.8	41.1	166.3	31.0	.049	1.00	.139	475.8	3.35	14
2148 Bag 62	75N/113E L. 1	187.0	76.2	41.5	165.0	31.3	.043	1.00	.143	477.8	3.62	14
					42Ws1632							
2149 Bag 33	64N/88E L. 1	187.5	78.3	37.5	157.8	28.8	.043	1.00	.138	475.0	3.33	14
					42Ws1633							
2150 Bag 92	BLM Tr. 0-50	182.8	38.4	35.5	156.7	34.2	.053	.83	.148	175.3	3.42	2

Source #14 = Modena area, Iron County, Utah
Source # 2 = Wild Canyon area, Mineral Mountain Range, Beaver County, Utah

APPENDIX F

CERAMIC ANALYSIS VARIABLE/VALUE LIST

by

Eric Blinman
Archaeological Support Services

Bag number: NNN

Catalog number: NNN

Temper/paste class: NN

00 No plastics

01 Indeterminate

02 Nonplastics predominantly angular to subangular, pale green to black, transparent to opaque particles; particles range from 0.1 to 1.0mm diameter and are often poorly sorted; nonplastics are relatively sparse (10-40% of paste); clay is slightly silty but less so than the clay of 05.

03 Nonplastics are predominantly subangular transparent (some translucent) clear or white; particles are fine (most less than 0.3 mm diameter); nonplastics are abundant (30-60% of paste); clay is fine, although the contrast between the clay and nonplastics may be obscured by vitrification.

04 Nonplastics are predominantly angular to subangular transparent (some translucent) particles; clear or white in color; particles are poorly sorted and range in size from 0.1 to 1.0 mm diameter; nonplastics are abundant (40-60% of paste); clay is fine; similar to temper 03 except in size range (and sorting) of nonplastics.

05 Nonplastics are heterogeneous, consisting of small and large suites of particles; the fine fraction (less than 0.2 mm diameter) includes rounded to subangular particles of mixed lithology; opaque white particles are most abundant, but both transparent and dark minerals are present; the coarse fraction (0.5-1.5 mm diameter) is sparse (20-30 percent of sherd cross-section) subrounded to angular particles of mixed lithology including transparent, opaque white, gray and rare dark particles; gray particles may include mica; paste is silty and sugary in appearance when vitrified; paste color may be brown under neutral firing conditions but may be gray, black, or red as well.

06 Nonplastics are predominantly subrounded to subangular transparent particles; particle size is coarse (0.5-1.0 mm diameter); some grains may be frosted and some may have adhering white cement, but cemented aggregates of grains not present; nonplastics are abundant (40-60%); clay fraction is fine, light colored, and homogeneous.

07 Coarse and crumbly paste; two distinct classes of nonplastics, one fine, one coarse; fine nonplastics (less than 0.2 mm diameter) are abundant rounded to subangular particles that are often clear but also include white and dark minerals; frosting may be present on rounded grains; coarse nonplastics (0.25-1.00 mm diameter) are sparse and heterogeneous, with variability in composition from sherd to sherd; coarse particles may include subangular to angular white fine-grained rock fragments or light-colored rock fragments with mica or dark mineral inclusions.

08 Identical with all aspects of 05 except for the presence within the coarse fraction of distinctive aggregates of small transparent rounded grains; aggregates are bound by a white cement and appear to be derived from a crushed sandstone; aggregates may be a minority particle type within the coarse fraction of 05 or may be the dominant particle type within the coarse fraction.

09 Nonplastics are medium (0.3-1.0 mm diameter) well rounded and frosted clear particles that are only rarely fractured; clay is fine-grained and homogeneous; some examples are extremely vitrified to the point of discoloration.

10 Nonplastics are coarse (0.5-1.5 mm diameter) subangular to angular white or tan particles (crushed potsherd) in association with subrounded to angular transparent or opaque white particles; these nonplastics can occur with a silty clay (like that of 05) or a fine-grained clay matrix (like that of 06).

11 Nonplastics are fine (0.2-0.5 mm diameter) opaque white particles that are usually subrounded and that may be lens-shaped rather than spherical; fine tranparent particles or particles of mixed lithology may be present as secondary nonplastics; clay is light in color, homogeneous, and fine-grained.

12 Nonplastics are coarse (0.4-1.0 mm diameter) subrounded to subangular particles that are generally dark in color and appear to be of mixed lithology; clay matrix is fine-grained.

13 Identical with all aspects of 05 except for the characteristics of the coarse fraction which are similar to 06; coarse particles are generally clear and are rounded to subangular in shape; coarse particles are moderately abundant, usually constituting 30-60 percent of the sherd cross-section.

14 Nonplastics are coarse (0.2-1.5 mm diameter) dark gray or black subrounded to angular opaque particles; particles are fine-grained (aphanitic) and could be derived from a basalt; clay is fine and homogeneous.

15 Nonplastics consist of subangular to angular gray or tan particles of crushed potsherd; nonplastics may include fine transparent or translucent particles that were the nonplastics within the sherds that were used as a temper source.

Firing Atmosphere: NN

0 not applicable
1 indeterminate
2 reduced
3 neutral
4 oxidized
5 poorly controlled reduction
6 poorly controlled neutral
7 poorly controlled oxidation
9 other

Surface manipulation: (NN) (exterior, interior)

0 not applicable
1 indeterminate
2 plain (wiped, scraped, or smooth but uneven)
3 filleted
4 clapboarded
5 coiled
6 corrugated (unelaborated)
7 corrugated (elaborated)
8 smooth but not lustrous
9 polished

Cover: (NN) (exterior, interior)

0 not applicable
1 indeterminate
2 none
3 fugitive red
4 slipped
9 other

Pigment type: (NN) (exterior, interior)

0 not applicable
1 indeterminate
2 none
3 organic paint (black)
4 mineral paint
5 mineral paint with organic binder
6 glaze paint
7 clay paint (white)
8 two paint types
9 other

Pigment color: (NN) (exterior, interior)

0 not applicable
1 indeterminate
2 none
3 brown/black
4 red/orange
5 white
6 polychrome (red and black)
7 polychrome (red, black, and white)
9 other

Prefiring form: NN

00 not applicable
01 indeterminate
02 bowl
03 seed jar
04 olla
05 cooking/storage jar
06 pitcher
07 indeterminate olla, cooking/storage, pitcher
08 jar body
09 bowl or jar body
10 feather box
11 "bird" effigy
12 "submarine" effigy
13 "dog" effigy
14 other or indeterminate effigy
15 figurine
16 miniature vessel
17 lug handle
18 strap handle
19 coil handle
20 recessed handle
21 open gourd dipper
22 bowl dipper
23 bowl dipper handle
24 pipe
25 ball or lump
26 coiled applique
27 vertical pinch
99 other

Postfiring modification: NN

00 not applicable
01 indeterminate
02 none
03 ceramic scraper
04 saucer form (abraded)
05 saucer form (chipped)
06 repair hole to maintain original form
07 pendant
08 jar modified into bowl
09 olla modified into seed jar
10 rim reshaped without changing vessel form
11 dipper wear
12 rim chippage wear
13 pendant blank
14 small regular form (abraded)
15 small regular form (chipped)
16 handle sherd, abraded at break from vessel
17 vessel sherd, abraded at break from handle
18 truncated sherd edge
19 rounded sherd edge
20 inner beveled sherd edge
21 outer beveled sherd edge
22 multiple beveled sherd edge
23 chipped sherd edge
24 scoop
99 other

Classification: NNN

000 not applicable

Indeterminate tradition

010 decorative class and ware unknown
020 utility (ware unknown)
021 utility, reduced
022 utility, neutral
023 utility, oxidized
030 decorated (ware unknown)
031 decorated, reduced
032 decorated, neutral
033 decorated, oxidized

Shoshonean (Paiute) tradition

100 decorative class and ware unknown
110 utility, oxidized

Virgin/Kayenta tradition

200 ware unknown

210 gray ware (class unknown)
211 plain gray
212 corrugated gray

221 smoothed but unslipped and unpainted
222 polished but unslipped and unpainted
230 painted white ware (class unknown)
231 Lino style
232 Kana'a style
233 post-Kana'a style
234 Black Mesa style
235 Dogoszhi style
236 Sosi style

Shinarump tradition

300 ware unknown

310 gray ware (class unknown)
311 plain gray
312 corrugated gray

321 smoothed but unslipped and unpainted
322 polished but unslipped and unpainted

330 slipped white ware without paint
331 slipped and painted white ware (class unknown)
332 Lino style
333 Kana'a style
334 post-Kana'a style
335 Black Mesa style
336 Dogoszhi style
337 Sosi style

Moapa tradition

400 ware unknown

410 gray ware (class unknown)
411 plain gray
412 corrugated gray

420 smoothed but unpainted
421 polished but unpainted

Moapa tradition, continued.

430 painted white ware (class unknown)
431 Lino style
432 Kana'a style
433 post-Kana'a style
434 Black Mesa style
435 Dogoszhi style
436 Sosi style

Kayenta tradition

540 Tsegi Orange Ware (class unknown)

Quantity: (NNNNNNNN)

Sherd count (old breaks): NNN
Sherd weight (total for catalog number): NNNN grams

Vessel association: NN

Refire clip number: (not coded, noted in comments)

Refired color: (not coded, noted on refiring data sheet)

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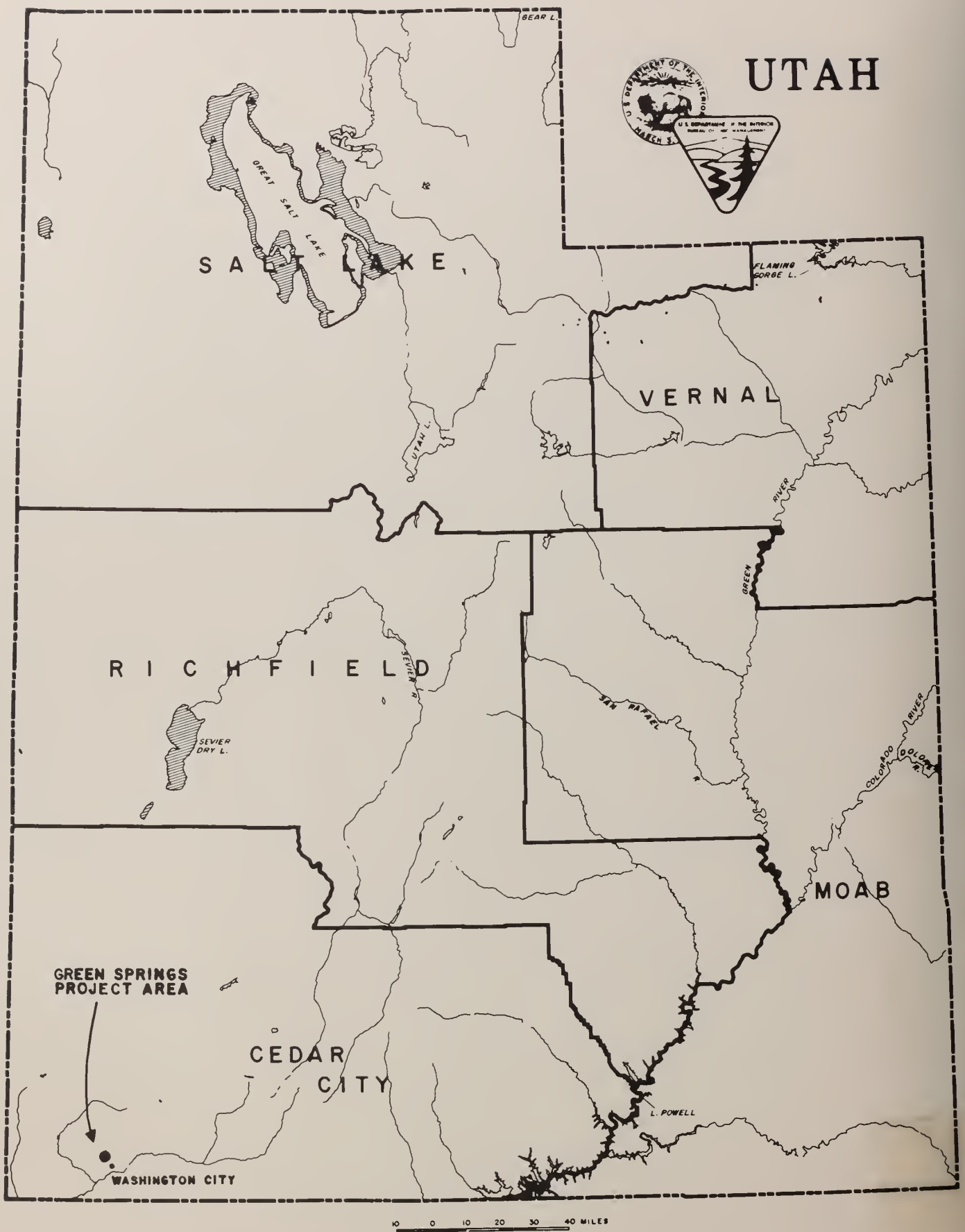
17 Gardiner F. Dalley and Douglas A. McFadden. *The Archaeology of the Red Cliffs Site.* (1985)

18 J.E. Bradley, W.R. Killam, G.R. Burns, M.A. Martorano. *An Archaeological Survey and Predictive Model of Selected Areas of Utah's Cisco Desert.* (1986)

19 K.D. Black and M.D. Metcalf. *The Castle Valley Archaeological Project: An Inventory and Predictive Model of Selected Tracts.* (1986) OUT OF PRINT

20 B.A. Walling, R.A. Thompson, G.F. Dalley, D.G. Weder. *Excavations at Quail Creek* With Ancillary Studies by K.M. Heath and L.W. Lindsay. (1986)

21 D.A. Westfall, W.E. Davis, E. Blinman. *Green Spring: An Anasazi and Southern Paiute Encampment in the St. George Basin of Utah* With Ancillary Studies by G.J. Edwards, R.H. Hevly, J.I. Mead and M.G. Taylor. (1987)


UTAH
GEAR L.
GREAT SALT LAKE
SALT LAKE
FLAMING GORGE L.
VERNAL
UTAH L.
GREEN RIVER
RICHFIELD
SEVIER R.
SEVIER DRY L.
SAN RAFAEL
COLORADO RIVER
MOAB
GREEN SPRINGS PROJECT AREA
CEDAR CITY
L. POWELL
WASHINGTON CITY
10 0 10 20 30 40 MILES